PUBLIC LIBRARY OF THE CITY OF DETROIT.

AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 30. WEEKLY. | NEW YORK, THURSDAY, JULY 28, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS

COPYRIGHT 1892, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

New Re-sawing Band-saw Machine.

We illustrate herewith a new re-sawing band saw which will use saws as thin as 24 gauge and up to 6 inches wide, and will saw 16,000 to 20,000 feet per day, making a kerf only $\frac{1}{16}$ of an inch, or less, instead of $\frac{3}{32}$" to $\frac{1}{8}$" more than this, as has been quite common.

The feeding is effected by four strongly geared live rolls, while two smaller idle rolls guide the last end of the stock up to the finish of the cut. Strong springs hold the rolls upon one side up to their work, and enable them to yield to all inequalities of thickness or shape, while the rolls upon the other side form a guide in perfect line with the saw, thus insuring a cut parallel with one side of the stock.

A friction device, controlled by a single lever, enables the feed to be instantly stopped and started, or to be run at any speed desired without changing belts, and thus the exact maximum feed can always be secured, resulting, of course, in increased output as compared with machines using stepped cones or gears.

The saw runs between hardened steel plates filled with dogwood plugs, with the end grain in contact with the saw, and each plate can be accurately adjusted by a single screw.

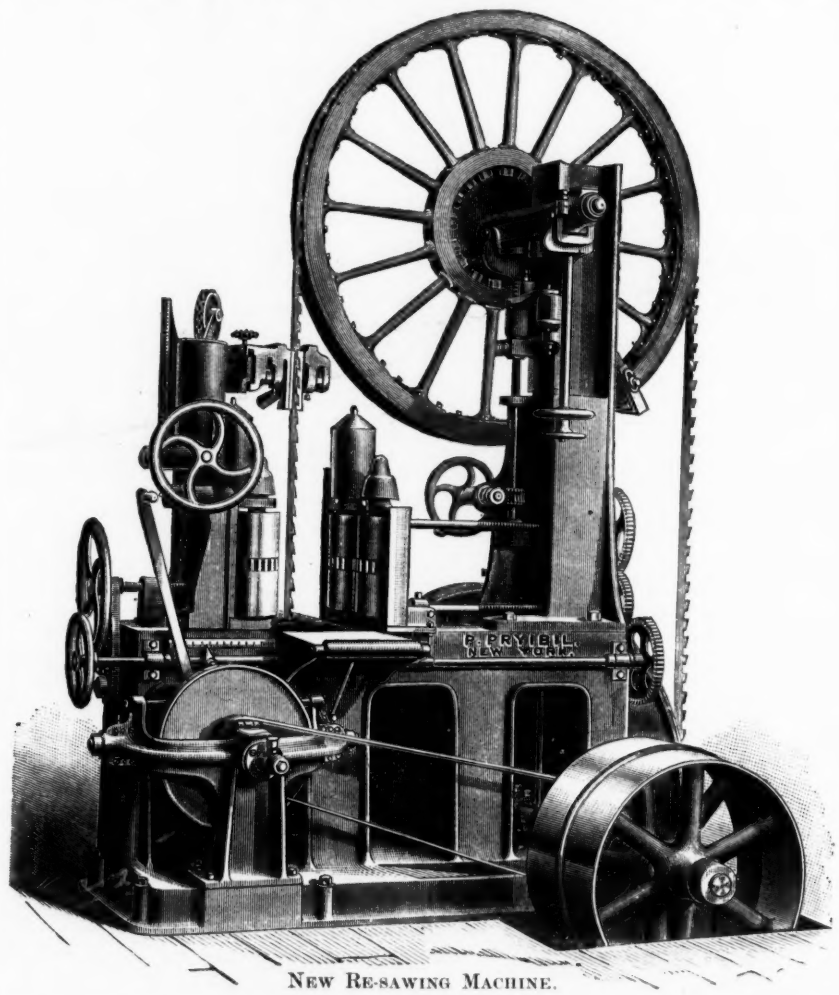
The back of the saw has a bearing $1\frac{1}{2}$ inches long on the beveled edge of a conical roller of a special composition, harder than steel. What little wear does occur takes place across the full width of the beveled surface, and therefore does not form grooves, as would be the case with a plain roller.

The upper guide is counterbalanced, and is adjustable vertically by a hand-wheel. This hand-wheel, the lever for controlling the feed, the hand-wheel for setting the feed rolls, and the scale showing to what thickness they are set, are all readily accessible from the sawyer's usual working position.

The upper wheel has a rim of bent ash with steel spokes, and the lower one is a heavy iron casting. The lower wheel being thus much the heavier, it acts as a fly-wheel to prevent sudden and violent fluctuations of speed, as in starting and stopping, and thus prevents the overrunning of the upper wheel, which, being lighter, is capable of following the motion of the lower one without causing the saw to slip or to become slack on the working side.

The rims of both wheels come upon a vertical line, which is considerably within the outer ends of the bearings, so that the shafts are well supported without the necessity for using outside bearings. The upper shaft can be angled while in motion.

An adjustable spring maintains a proper tension on the saw, and renders it much more secure against breakage than the weights commonly used for this purpose, as the inertia of weights prevents them from yielding quickly enough when a chip gets between the saw and the wheel, the result being a broken saw. To provide doubly against such an accident, a wooden block is fitted in the throat between saw and wheel, so as to catch all chips and sawdust, and discharge them beyond the rim. The lower wheel is kept free from accumulations of sawdust by a scraper, and the upper one by a brush.



NEW RE-SAWING MACHINE.

The loose pulley is self-oiling, and one inch smaller in diameter than the tight pulley, to slacken the belt when the machine is stopped, and it is provided with a step at the inner edge, to cause the belt to shift easily. Height of machine, 10 ft. 7 in.; width of machine, 7 ft. 5 in.; depth of machine, 6 ft. 5 in.; weight complete, 7,000 lbs ; diameter of wheels, 60 inches; driving pulley, 22 to 30 in. diameter, as ordered, for an 8-in. belt; speed, 450 to 525 turns per minute, according to kind and width of lumber; thickness taken between feed-rolls, 21 inches—12 in. on one side of the saw and 9 inches on the other; height of stock that can be sawed, 30 inches. The manufacturer is P. Pryibil, 498 to 510 West Forty-first street, New York City.

The body is a box-shaped casting, in one piece, very strong and rigid, and it can be placed on any good floor without a special foundation.

The Rivett Bench Lathe.

We publish on this and the succeeding page some illustrations of a bench lathe, which, with its attachments, possesses many points of interest to the mechanic. The engraving on this page represents the lathe as arranged for milling, while on the next page are engravings showing it in its plainest form; with the grinding attachment ready for use, and also some of the attachments by which it is made to do a great variety of work.

The lathe is intended for the finest work done by tool makers, electricians and machinists, and is highly finished all over, including the bed and feet. The head-stock spindle and bushings in which it runs are of tool-steel, hardened, ground and lapped, the spindle being $2\frac{1}{8}$" diameter, and the bearings $2\frac{3}{8}$" long. The end of the spindle is threaded for face plates or chucks, and there is a draw-bar which extends through the spindle for holding split chucks which vary in size from $\frac{1}{32}$" to $\frac{1}{2}$", the rods extending through the spindle, which has a hole through it $\frac{3}{4}$" diameter The cone has three steps for a $1\frac{1}{4}$" belt, the smallest step being 3" and the largest $4\frac{1}{2}$" diameter. The flange at the rear end of the cone is drilled and provided with a pin for indexing.

The foot-stock spindle is also of steel, hardened and ground, 1" diameter, and with a bearing 5' long. The lathe swings over the bed 8", and takes between centers 18".

The slide rest, which is shown on page 2, Fig. 4, fits over the sides of the block, on which the T-rest is placed in Fig. 2. It has two circular graduated bases and two slides, the lower one of these being always at right angles to the center line of the lathe, so that a squaring or facing cut can be taken at any time when boring or turning taper without disturbing the adjustment of the rest. The various binding arrangements are efficient, operating to hold the parts very securely with very light pressures.

The tool holder is an eccentric device by which the tools are readily brought to the center or otherwise adjusted, and it is especially arranged with a view to enabling the tool maker to make his own tools where the services of a blacksmith or tool dresser are not at command, as is often the case where such lathes are used. The lower or cross-slide has a movement of 4" and the upper slide 5".

At Fig. 5 is shown a block which clamps to the bed in the usual way, the upper portion of this block swiveling in a horizontal plane upon a graduated base. The left-hand side of this block as shown in the engraving is adapted to receive the slide

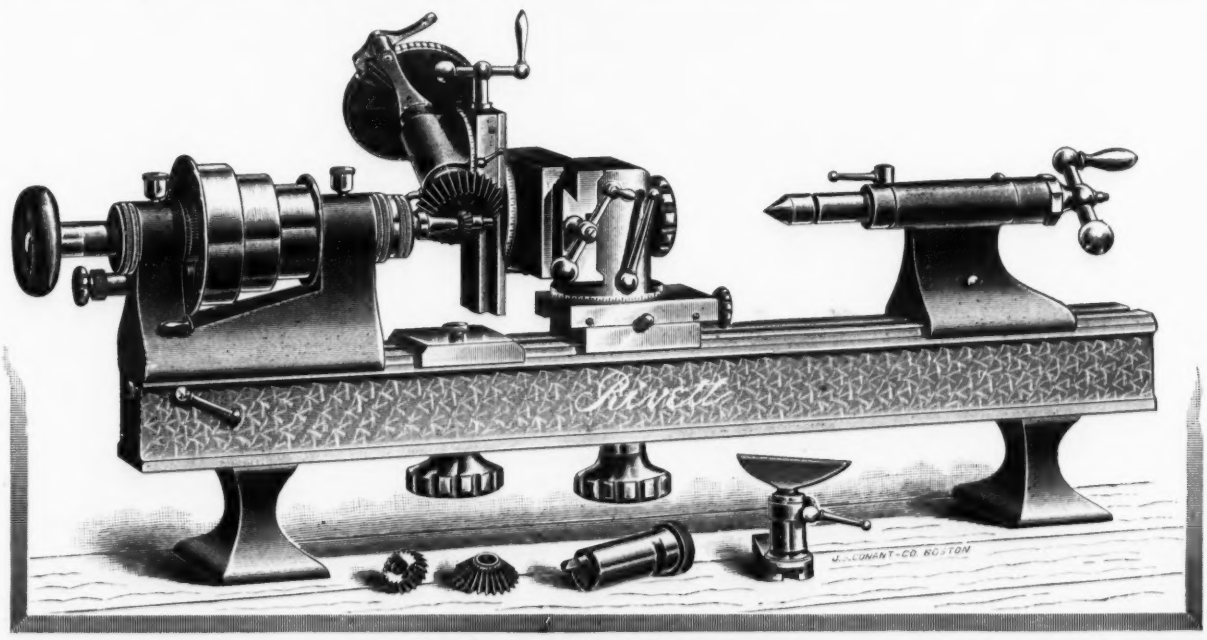


Fig. 1.—THE RIVETT BENCH LATHE.

rest in the manner shown in Fig. 1, where the slide rest is so placed as to hold an arbor on which is placed a blank for an angular milling cutter to have teeth cut in it, the various slides and graduated bases constituting a means of placing the work arbor in any possible position that may be wanted for doing almost any kind of work. Arranged thus, the lathe is, of course, very useful for cutting gears, bevel or spur, or for doing any kind of intricate and fine milling work. Gears up to 4′ diameter and 12 pitch can readily be cut upon it. Index plates with 46, 56, 60, 72, 80, 84 and 100 teeth are supplied with the device. It will be perceived that this device can be put in place very quickly, and that no extra belting is required, the machine being ready for use as soon as the rest is in place. Fig. 6 shows the quill used in milling, this being put in place of the ordinary tool holder, and clamped in place by the same means.

Fig. 3 shows the lathe and countershaft fixed for grinding, the grinding attachment being shown at Fig. 7. This also slips in place of the tool holder, and is belted in the manner shown, the large grooved wheel and guides being preferred by the builders to the usual drum. Here again the universal adjustments of the slide rest are useful in making the grinding device applicable to almost any kind of outside or inside grinding.

An automatic feeding device is supplied for the slide rest when desired, by which screws from 10 to 160 per inch can be chased by the gears regularly furnished, or gears for metric threads are supplied when desired.

There is also a turret slide which goes on the bed in place of the footstock, the slide rest being used in connection with this. The turret is moved by a lever, and revolves automatically. It has six $\frac{11}{16}$″ holes for tools. An automatic wire feed is also supplied when desired, making the lathe a complete screw machine.

A smaller lathe of the same general design is also made by the Faneuil Watch Tool Co., of Boston, Mass., of which Messrs. Hill, Clarke & Co. are the selling agents.

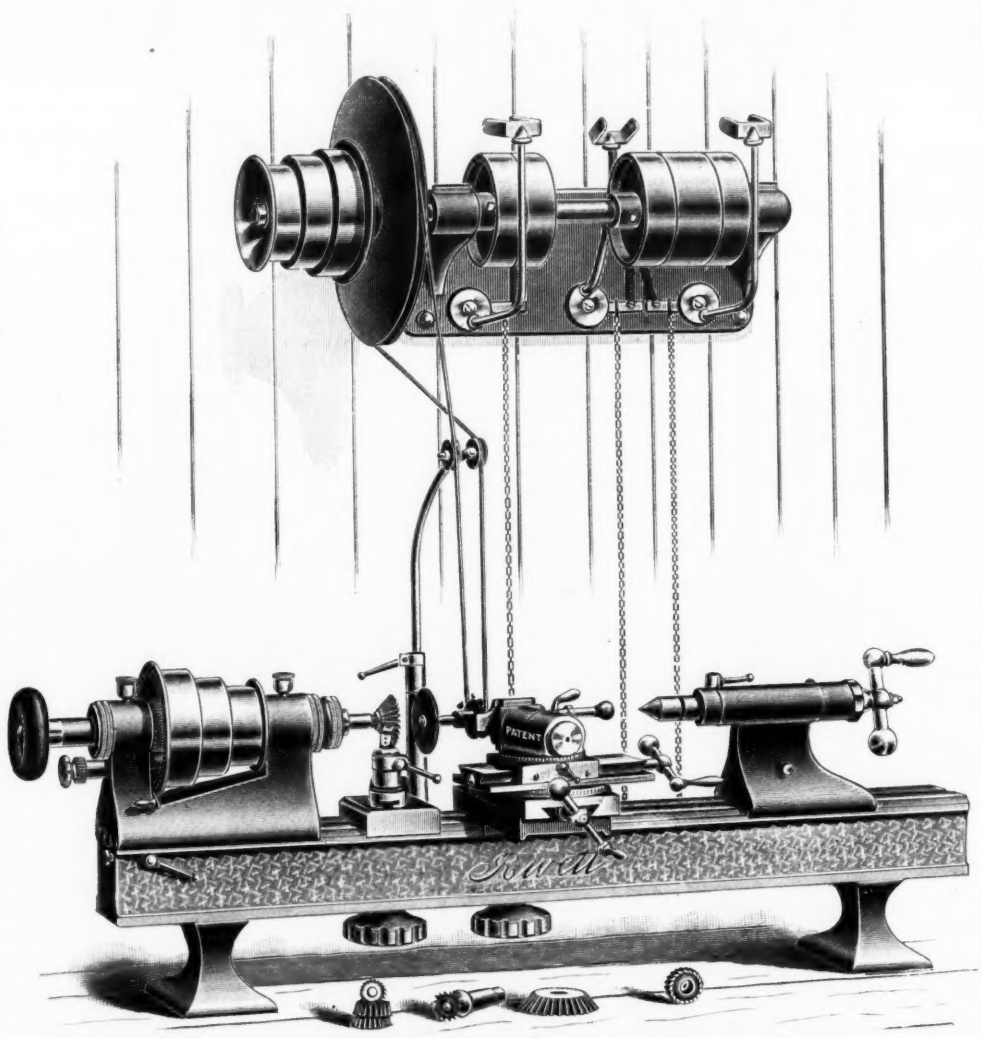


Fig. 2.

Fig. 6.

Fig. 7.

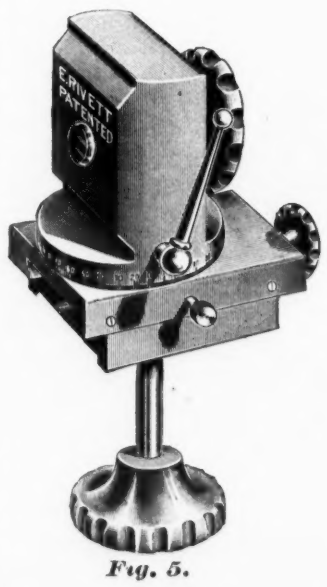


Fig. 5.

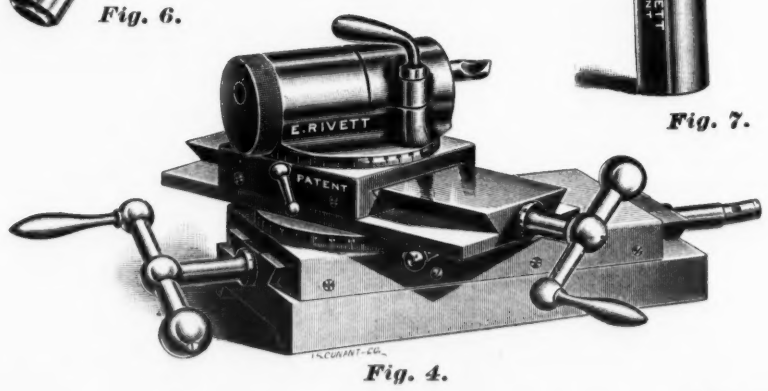


Fig. 4.

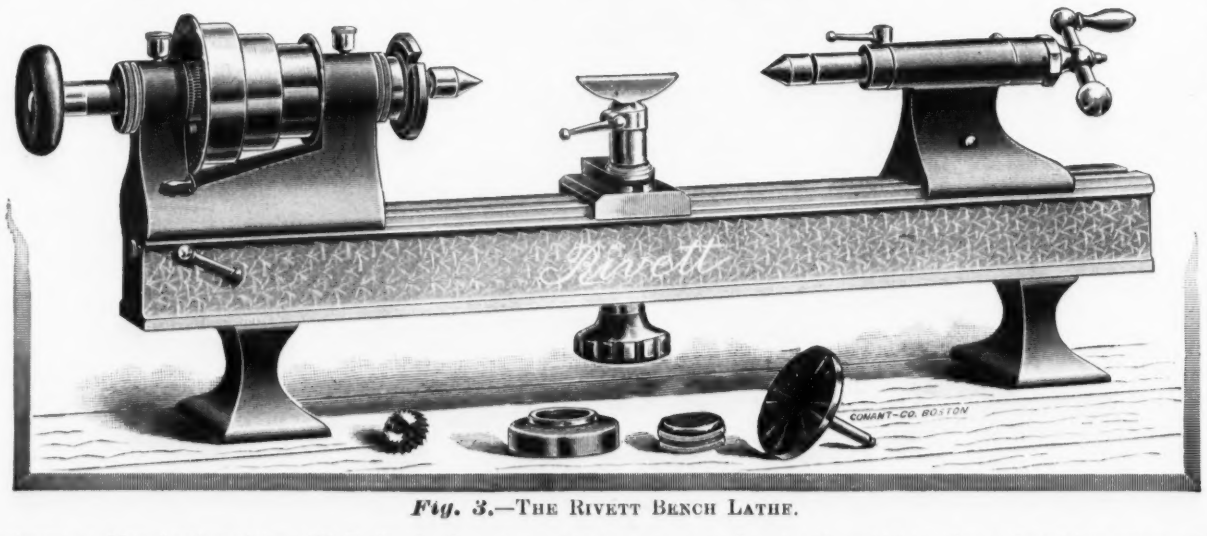


Fig. 3.—THE RIVETT BENCH LATHE.

A Proposed "Destroyer."

Considering the question of sending vessels of war to destruction by torpedoes, or ramming them to pieces by sheer *vis viva* properly applied, the following communication to the *Tribune* will be found of interest:

A MODEL LIKE THE DESTROYER.

DESCRIPTION OF A VESSEL WITH SUBMARINE GUNS PROPOSED IN 1862

To the Editor of the *Tribune*:

SIR—I notice in the *Tribune* of July 3 a cut and description of a vessel called the "Destroyer," said to have been invented by the late Captain John Ericsson, and it calls to mind an invention of my own, of precisely similar character and intent, which I laid before the Navy Department in May, 1862. The Board of Examiners who reported upon my plans consisted of Commodores Shubrick and Wilkes, now deceased, and Naval Constructor Pook. Their report was as follows:

The Board of Examiners have, as instructed by the department, examined the plans and model of W. F. Durfee for a steam battery. The bottom of the model is similar in form to what has been the usual practice, except at the bow, into which is built a gun to be fired under water. The lines of the forward part of the vessel are made to converge into and are terminated by the gun, which also may be used as a ram. He also proposes two guns to be placed amidship, also to be fired under water. The form of these guns and the manner of working them are very ingenious. If guns can be used under water to advantage (of which the board has serious doubts), the plans proposed by Mr. Durfee to work them are more feasible than any yet offered for examination. There is also to be one revolving tower amidship, and one fixed tower in the forward part of the vessel, with the gun revolving upon a platform. It is proposed to have the guns so mounted that they are turned, elevated or depressed in the center of the port, so as to make the ports as small as possible. The plans are well conceived and show much ingenuity, and Mr. Durfee deserves great credit for his efforts to produce an efficient ship; but, after a careful examination of his plans and listening to his explanations, the board has come to the conclusion that, until more reliable experiments are made to test the efficiency of guns fired under water, they cannot recommend this plan for adoption. The manner of mounting the gun in the tower, the muzzle to rest in a chock upon the end of the carriage, when elevated or depressed, would be found difficult in practice and not reliable. The gun built into the bow of the vessel, with the addition of the tower, would be too much weight in that end of the vessel, and could not be supported in the manner proposed. The iron shield over the rudder is also objectionable, as it cannot be supported and would weaken the vessel. The weights at the extremities should be avoided as much as possible. This plan is not recommended for adoption.

The gun built into the bow of the vessel, mentioned in the above report, was designed to serve both as a gun and a ram (that in the "Destroyer" cannot be used as a ram, because of the presence of the muzzle shutter, which ramming would destroy), and was contrived to open at the breech without admitting water to the vessel. The design also contemplated the use of breech-loading broadside guns, which could be fired below the water line. These guns were provided with pneumatic recoil cylinders, and it is believed that this was the first proposal to use such cylinders for regulating the recoil of heavy guns. The caliber of the bow gun was proposed to be twelve inches, and that of the broadside guns eight inches.

The midship turret was so arranged that the officer commanding it had full control of its movements without communicating with the engineer, and could stop, start or reverse at his pleasure. Furthermore, it was so designed that in case the deck was swept by a sea no water could get into the vessel beneath the turret, while at the same time the sides of the turret were entirely clear of the deck and were not liable to be jammed by the impact of shot near the deck. While perhaps some of the minor criticisms of the Examining Board may have had some force at the time they were made, I am still of the opinion that the leading principles embodied in the vessel proposed (which are identical with those of the "Destroyer") by me in 1862 are sound, and with thirty years of active experience as a civil and mechanical engineer to aid my judgment since that date, I am still firmly of the opinion that a vessel constructed substan-

tially as proposed would be very efficient as a means of harbor and coast defense. I claim to be the original inventor of a vessel having a breech-loading gun built into its bow, arranged to discharge shot or shell below the water, and capable of being used as a ram without destroying its use as a gun, and of being loaded and fired without letting water into the vessel. I also claim the construction of the turret described and the method of mounting the guns therein.

W. F. DURFEE, Engineer.

West New Brighton, S. I., July 4, 1892.

Engines for the U. S. Battle-ship "Texas."

With this we give a longitudinal section and an end view of the engines for the U. S. Battle-ship "Texas," which was successfully launched from the Norfolk Navy Yard on the 28th ult. A full description of these engines was given in our issue of June 30th.

These illustrations will give an excellent idea of the general design, arrangement and type of valves, and link motion used.

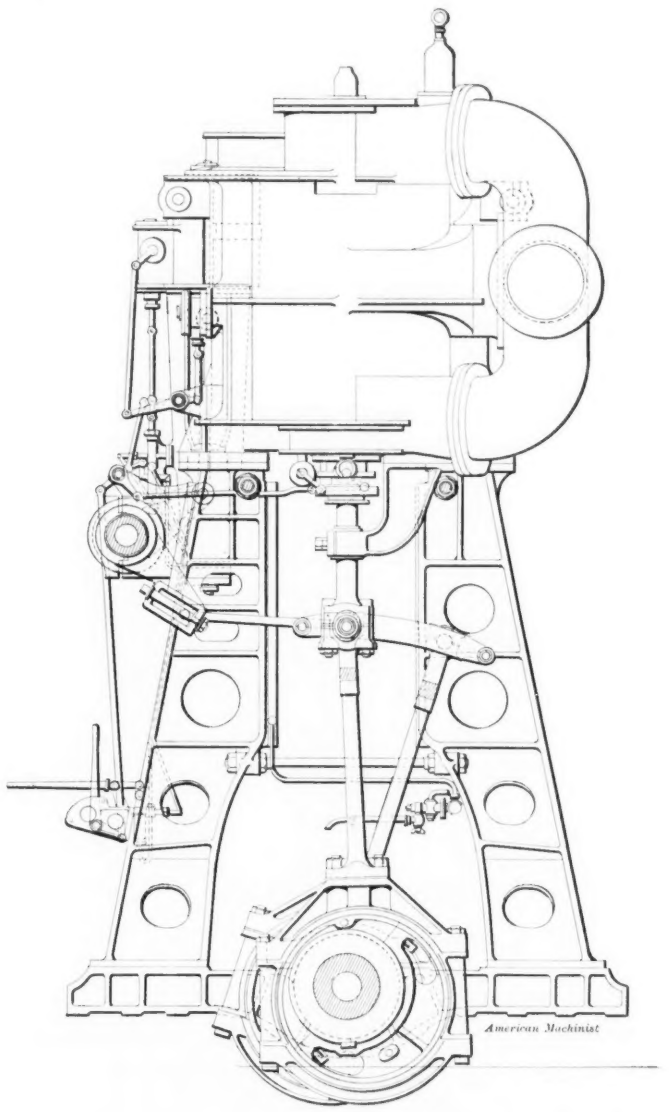
The "Texas" will be fitted as a flagship, and will carry a complement of 368 officers and men.

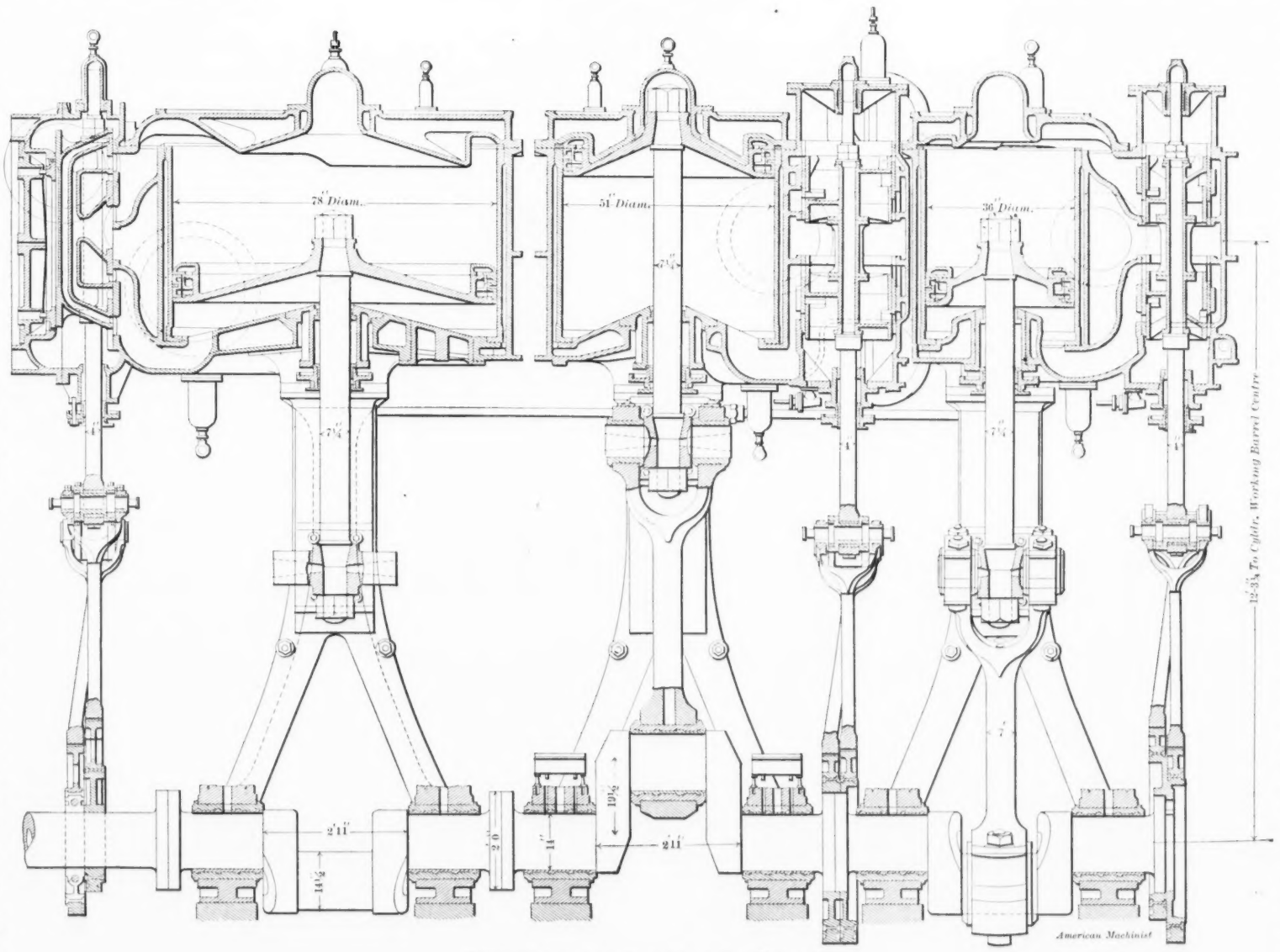
The Compound Engine.

BY WM. H. WEIGHTMAN.

The aim to carry out and employ higher steam pressures, and the advisability of making the best possible and most economical use of the steam after its generation, gave rise to the present development and introduction of the compound engine. The compound engine is a combination of the high and low-pressure engines, the high-pressure engine operating with the high initial boiler pressure against a varying lower pressure exhausted to be made use of in a second or low-pressure cylinder, generally, and preferably connected to exhaust into the vacuum of a condenser. The high-pressure cylinder, therefore, only makes a partial use of the expansion abilities of the steam, reserving the balance for the low-pressure cylinder. The steam is generally exhausted from the high-pressure cylinder into an intermediate chamber or chest, where it is held ready for use and admission into the low-pressure cylinder. At times there are two such low-pressure cylinders, making the complete combination that is called a three-cylinder compound engine. Again, the steam after being used in the high pressure cylinder is exhausted for use in a second cylinder, and again exhausted from the second cylinder into a third, for use and expansion, finally reaching the condenser.

A standard ratio of areas or diameters of the cylinders in compound engine practice has not been and in all probability will never be settled upon, since surrounding conditions and the necessities of detail construction will necessarily have great influence in the work of design. The power to be developed governs the size of the low-pressure cylinder or cylinders, and space and opportunity control the size of the high-pressure cylinder. Naturally, while the mean and final pressures should be steady, for regular working operation and economy, the size of the high-pressure cylinder can be gauged by the allowed pressure upon the boiler, and the possible room to be taken up. The exhaust of the high-pressure must be such as to furnish an easy supply of steam for required use in the low-pressure cylinder or cylinders. The lower the boiler steam pressure, the larger the higher pressure cylinder must necessarily be. As the initial or boiler pressure increases, the ratio between the areas of cylinders will increase. The product of the areas of the cylinders by the mean effective steam pressure acting upon the pistons should be as near alike as possible, likewise the initial loads at steam admission should be as near regular and equal as possible.





ENGINES FOR THE BATTLE-SHIP "TEXAS."

For every increase in the initial pressures, the expansion ratios will increase for equal powers and mean pressures; with increased initial pressures, however, increased initial strains will be developed upon the several parts. When the low-pressure cylinders are used, their diameters are preferably made alike, and the high-pressure cylinder is made of sufficient size to supply both.

The local engine advantage gained by this division of the work of the steam consists in the reduced exposure of the steam to extreme temperatures at initial and exhaust ends of the stroke; and, the pressure upon and the work of the pistons is more steady and regular, bringing the work of the metal nearer to its initial requirements than would result were the expansion and work accomplished within the single cylinder. In ordinary non compound condensing engines the steam is compelled to meet a sudden change of temperature, since it enters the cylinder almost immediately after the closing of the exhaust to the condenser. The average exhaust and condenser temperatures is about 150° to 160° Fahr., and the exhaust ports being closed and steam admission commenced, subjects the steam to a loss of heat in re-heating the cylinder metal to steam pressure temperature, changing some portion of the steam to water, effecting what is termed liquefaction. During its expansion and work the steam releases or loses some more of its heat, a portion of which is again taken up from the metal of the cylinder, causing a re-evaporation. Such re-heating and re-evaporation, however, take place too late for engine usefulness, the condenser receiving it with the exhaust steam.

A portion of this heat trouble is overcome in the compound engine, since, the variation in temperature occurring only in proportion to the variation in pressures, the cylinder metal takes up and gives out less. This is effected by the intermittant expansion brought about by the use of the several instead of the single cylinders.

To ascertain the increase in theoretical efficiency due to carrying increased steam pressures, the difference between the ab-

solute temperatures of boiler steam and condenser vapor should be taken, and this divided by the absolute temperature of the boiler steam. Thus, assuming a temperature of say 150° Fahr., or about 4 pounds absolute pressure, the heat efficiency at 200 pounds absolute steam pressure and 381.7° temperature will be equal to

$$\frac{(381.7 + 460) - (150 + 460)}{(381.7 + 460)} = \frac{841.7 - 610}{841.7}$$

= .2752, or 27.5 per cent.

The heat efficiency for 300 pounds absolute steam pressure, and a temperature of 417.5° Fahr., and a condenser or exhaust temperature of 150°, will be equal to

$$\frac{(417.5 + 460) - (150 + 460)}{417.5 + 460} = .3048, \text{ or}$$

30.48 per cent; a gain of 30.48 — 27.52 = 2.96 per cent. For a steam pressure of 150 pounds the efficiency is 25.45 per cent. These are comparative theoretical efficiencies; the actual efficiency will at all times be found much less, due in general to the condensation and interchange of temperatures within the cylinders while at work. The relative value of the several temperatures and pressures, however, remains the same. The gain in efficiency from 75 pounds, the original compound pressure, to 150 and to 200 pounds, the present pressures, may be rated between 22, 25 and 30 per cent., or from 14 to 37 per cent. increase in efficiency of the 150 to 200 pounds over the 60 pounds of original pressure.

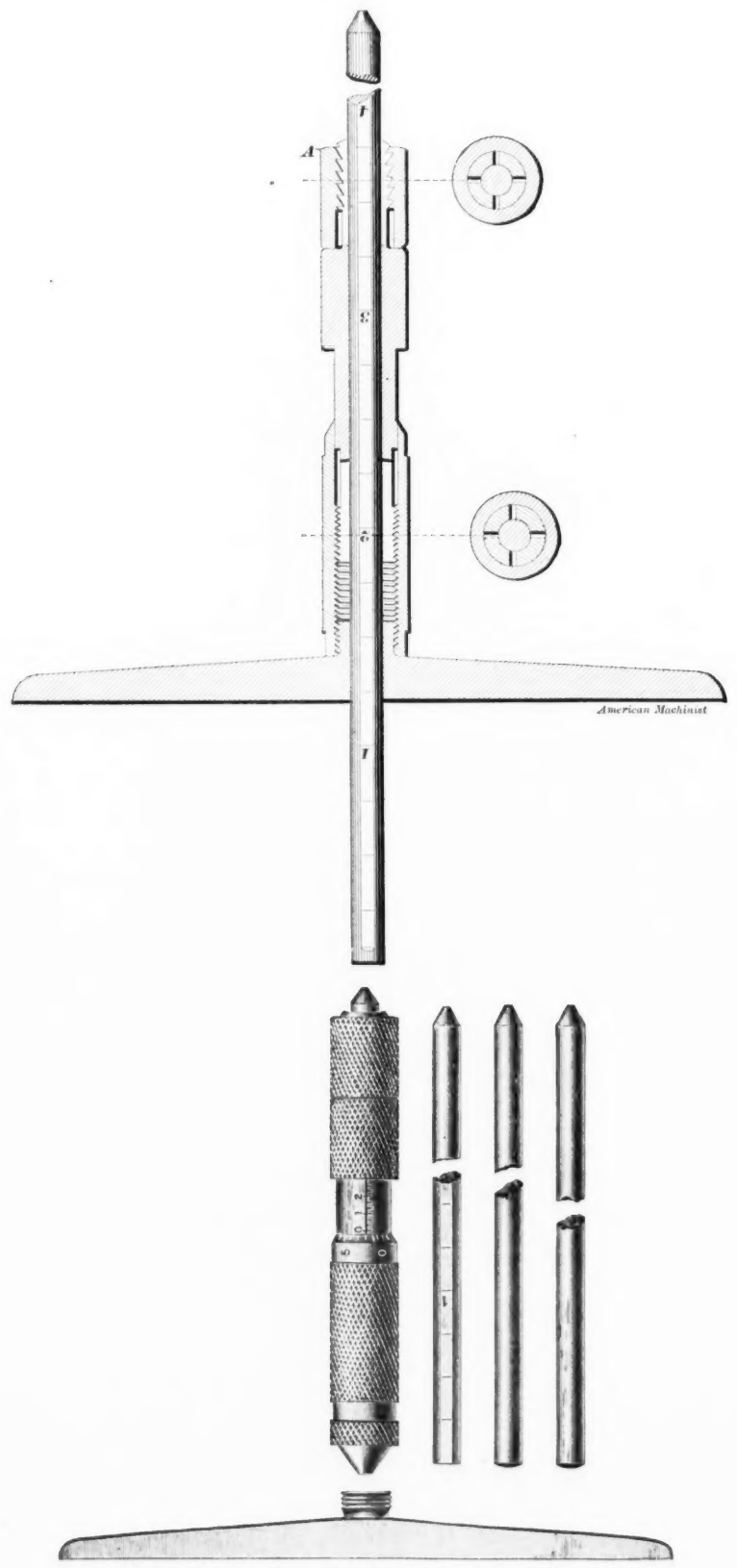
There is an advantage due to the intermitting expansion of the steam in the two or more cylinder compound engines, and the reduced exposure to change of temperature. For instance, in a condensing engine, with the initial steam temperature at 307.50 for 75 pounds absolute pressure, and the exhaust or condenser temperature at 150, the fall of temperature within the cylinder will be 307.5° — 150° = 157.5°. With these same temperatures in a compound, the fall of temperature being made about equal in each of the high and low-pressure cylinders, will be 157.5 ÷ 2 = 78.7°. With the initial steam at a temperature of 366° for a pressure of 150 pounds by gauge, and 165 pounds absolute, the change being equal in each cylinder, the fall in temperature will be 366 — 150 = 216°, or 108° for each of the high and low-pressure cylinders of a compound engine, and 216 ÷ 3 = 72° for each of the cylinders of a triple-expansion engine.

To effect a direct comparison of efficiencies in the simple, the compound and the triple-expansion engines, a single-cylinder engine is selected, operated under 150 pounds steam pressure by gauge, and making 20 expansions for economical operation. The mean pressure in such case would be found by dividing 1 + hyp. log. of expansions by the number of expansions. (1 + hyp. log. 20) ÷ 20 = 1 + 2.9957 ÷ 20 = 3.9957 ÷ 20 = .199785 and 165 pounds absolute initial pressure multiplied by .199785 gives a mean pressure of 32.96 pounds. Deducting 4 pounds for back pressure gives a mean effective pressure of 28.96 pounds per square inch of piston, and this latter multiplied by the area of piston in square inches gives the total mean effective pressure.

With the same pressures and total expansion rate operating in two successive stages, or on the compound principle, and assuming the high-pressure expansions at 5 and the low-pressure expansions at 4, the mean pressure in the high-pressure cylinder will be equal to 165 (1 + hyp. log. 5) ÷ 5 = 165 (2.6094) ÷ 5 = 165 × .52188 = 86.11 pounds, and the final pressure will be 165 ÷ 5 = 33. With no loss of pressure between the two cylinders, the initial pressure of the large or low-pressure cylinder will be the same as the final pressure of the small or high-pressure cylinder, or 33 pounds per square inch. Subtracting this 33 pounds from the 86.11 pounds, gives 53.11 pounds as the mean effective pressure. Working under 4 expansions, the mean steam pressure of the second cylinder will be equal to 33 (1 + hyp. log. 4) ÷ 4 = 33 (2.3863) ÷ 4 = 19.687 pounds, and 33 ÷ 4 = 8.25 pounds final pressure. Deducting 4 pounds from the 19.687 gives 15.687 pounds per square inch as the mean effective pressure. Dividing 53.11 pounds, the higher mean effective pressure, by 15.687 pounds, the lower mean effective pressure, gives a cylinder area ratio of 1 to 3.385. Dividing 53.11 by the 3.385, to reduce it to the terms of the low-pressure cylinder, the sum of the mean pressures will be 31.374 against 28.96 mean pressure of the single cylinder engine, a possible gain of 31.374 — 28.96 = 2.414 pounds per square inch mean effective pressure.

Again, with the same pressure and total expansion rate operating in three successive stages on the triple expansion principle, and the cylinder having in turn 3⅓, 3 and 2 expansions, the mean pressure of the steam in the first cylinder will be equal to 165 (1 + hyp. log. 3.33) ÷ 3⅓ = 165 times .6609 = 109.05 pounds per square inch, and 165 ÷ 3⅓ = 49.5 pounds, the final pressure per square inch in the first cylinder. With no loss between the cylinders, the initial pressure of the second cylinder will be the same as the final pressure of the first cylinder, or 49.5 pounds Deducting this 49.5 pounds from the 109.5 gives the mean *effective* pressure of the first cylinder at 59.55 pounds.

With an initial pressure of 49.5 pounds working under 3 expansions, the mean steam pressure of the second cylinder will be equal to 49.5 (1 + hyp. log. 3) ÷ 3 = 34.63 pounds. The final pressure will be equal to 49.5 ÷ 3 = 16.5 pounds, and assuming this final for the initial pressure of the third cylinder for the third stage of expansion gives 34.63 — 16.5 = 18.13 pounds mean *effective* pressure for the second cylinder. For the third cylinder, the initial pressure being 16.5 pounds per square inch working under 2 expansions, the mean pressure will be equal to 16.5 (1 + hyp. log. 2) ÷ 2 = 8.25 × 1.6931 = 13.968 pounds per square inch. The final pressure will be 16.5 ÷ 2 = 8.25 pounds, and the condenser pressure at 4 pounds absolute gives a mean *effective* pressure of 9.968 pounds per square inch. The ratio of the cylinder areas will be inversely as the mean effective pressures, or 1 to 3.3 and 5.



INSIDE MICROMETER CALIPER AND DEPTH GAUGE.

Putting the expansions the same in each cylinder of a triple-expansion engine, the cube root of 20 = 2.714 will represent the expansions for each. Then the hyp. log. for each rate will be .9984, and (1 + hyp. log. of 2.714) will equal 1.9984, and 1.9984 divided by 2.714 equals .736. Then 165 × .736 = 121.44 pounds mean pressure for the first cylinder, 165 ÷ 2.714 = 60.8 initial pressure for second cylinder, and 60.8 × .736 = 44.75 pounds mean pressure; 60.8 ÷ 2.714 = 22.4 pounds final pressure for the second cylinder, and the initial pressure for the third cylinder; 22.4 × .736 = 16 4864 pounds mean pressure for the third cylinder, and 22.4 ÷ 2.714 = 8 26 pounds, the final pressure. The mean effective pressures, then, or the mean pressures less the back pressure of the three cylinders, are 121.44 — 60.8 = 60.64 pounds for the first or high pressure, 44.75 — 22 4 = 22.35 pounds for the second or intermediate cylinder, and 16.4864 — 4.00 = 12.4864 pounds for the third or low-pressure cylinder. This last four pounds is for the condenser back pressure. The theoretical areas, then, of the three cylinders, will be as 1 to 2.71 and 4.71.

Arranging a table based upon the above data gives the following engine work:

LINES.		SINGLE CYLINDER.	COMPOUND CYLINDERS.			TRIPLE-EXPANSION CYLINDERS.			
	Diameter of cylinders, inches	60	33	61	1	28	46	61	1
	Area ratios	—	1	3.416	2	1	2.70	4.746	2.2
	Expansions	20	5	4	3	2.714	2.714	2.714	3
1	Initial steam pressures—absolute and effective—pounds	165	165	33	4	165	60 8	22 4	4
2	Mean pressures, pounds	32 96	86 11	19.68	5	121.44	44 75	16 49	5
3	Mean effective pressures, pounds	28.96	53.11	15 68	6	60.64	32.35	12 49	6
4	Steam temperatures into cylinders	366°	366°	259° 9	7	366°	293° 5	234° 1	7
5	Steam temperatures out of the cylinders	184° 2	259° 9	184° 2	8	293° 5	234° 1	184° 2	8
6	Difference in temperatures	181.8	106.1	175.7	9	72 5	59 4	49.9	9
7	Horse-power developed	800	399	403	10	269	208	264	10
8	Speed of piston	322	290	290	11	298	298	298	11
9	Total initial pressures on pistons, pounds	455,218	114,900	84,752	12	64,162	62,817	53,773	12

To develop the horse-power necessary to the differences arising between theoretical and actual mean pressures and resulting powers, an increase in the speed of piston may be provided for up to 20 to 25 per cent. To determine the maximum strains transmitted through each of the several cylinders, the product of the initial effective pressure by the area of piston, these loads are indicated on line 12 of the Table; the initial effective pressures are indicated on line 4.

The advisability of adopting engines of the compound type depends upon the uses to which they are to be put. Where there is a steady and continued run of some hours, their usefulness is clearly apparent. Where, however, starting and stopping is the prevailing feature of the engine use, their usefulness is at the lowest minimum. In starting up, live steam has to be admitted into the second and sometimes the third cylinder, and for this reason the evident economy in the use of the compound is overcome or greatly reduced by the loss in high-pressure steam used for such purposes, necessitating extra strength in the several operating parts to meet the requirements of initial high pressures.

Inside Micrometer Caliper and Depth Gauge.

The accompanying engravings illustrate a new tool intended to measure inside diameters above 2½", and which is also adapted to be used as a depth gauge.

By referring to the detail engraving, it will be seen that the graduated wire is held in any desired position by the chuck which is formed at the top of the tool, the shank being split and provided with a ratchet thread, so that, when the knurled nut is tightened up, the strain coming upon the angular side of the thread closes the split end upon the wire and firmly clamps it. The lower end of the shank is also split, as shown by the cross section at the right, and, since the thread is made a very tight fit in the micrometer barrel, when split it forms a spring fit which automatically adjusts for wear, and always works smoothly. The micrometer screw has a range of ¼", and provision is made for setting the graduated wire very accurately, so that by this tool it is entirely practicable to know what the

character of a loose, a working, a driving or a shrink fit may be in thousandths of an inch, as is now almost universally done on smaller work, instead of making such fits by a system of skilled guessing.

The change from caliper to depth gauge is made by simply removing the hardened contact piece from one end of the tool and substituting the bar, which is the work of but a very few minutes, when depths can be as accurately measured. This bar is hardened and ground accurately, and the ends of the measuring wires are also hardened and ground. Wires are furnished for measuring up to 9", and any greater diameter or depth may be measured by cutting off the required length of $\frac{5}{32}$" wire. The tool is made by J. T. Slocomb & Co , Providence, R. I.

On the Cultivation of the Inventive Faculty by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

A number of solutions to the triangular movement problem remain to be noticed, very briefly, before I propose a new problem. Herewith, also, as there have been no solutions to the problem given in issue of December 3 handed in, I will, as promised, give the solution.

The solution of the triangular movement forwarded by Mr. F. A. Risdon, of Waterbury, Conn., and shown in Fig. 1, introduces the feature of a link connection between the driving-arm and the needle-block, which, minus the spring, is substantially the same as a solution forwarded by Mr. Adam Gerlock, of Tioga, N. Y. Mr. Gerlock, while using the link, avoids the spring by the use of a sliding frame analogous to that employed by Mr. Theo. H. Miller in his solution published in issue of June 9; but the construction of the sliding frame is rather more simple than that of Mr. Miller.

Mr. Leland Dougherty, of Three Rivers, Mich., who styles himself a "tyro" in mechanical design, has proved himself anything but a tyro in geometrical analysis of mechanical movements, by a very interesting discussion of the polar co-ordinates of conchoid curves that will guide the needle-block in the required path. As he does not accompany the discussion by any drawing of devices that will effect the movement, merely sending diagrams that are not complete enough for reproduction, or as a guide to the making of an adequate drawing, and as the effect of conchoid curves has already been shown in the solution of Mr. Carl J. Ulmann, printed in the issue of June 9, I have thought it best not to occupy space with the purely geometrical discussion, more especially as the latter is rather lengthy.

A variation of the link connection between the needle-block and the driving-arm is shown by Mr. Herbert W. Pudan, of Sacramento, Cal., who, in his solution, instead of a link to give the desired flexibility, uses a flat coiled spring as a substitute for both the arm and its connected link, the inner end of the spring being attached to the central rotating shaft, and the outer extremity connected with the pintle in the needle-block. Another solution sent by him has more than the required number of moving parts.

Mr. A. Schiefer, of Fern Bank, Ohio, has also sent in a solution substantially like that of Mr. F. A. Risdon, given above, except that he uses no spring, relying upon a double triangular block like that used by Mr. Theo. H. Miller, shown in the issue of June 9. He uses slots, one in the end of the main driving arm, and one in the end of the link, the connecting pin playing in these slots, thus enabling him to reverse the motion of the needle-block at will.

The attempted solution of Mr. William N. Risdon, of Watsonville, Cal., does not conform to the requirements of the problem as it was enunciated, as the needle center describes curves in turning the corners. It is, however, an excellent effort for a boy who says he is "only a cub of 17 years." I trust one failure will not discourage him.

I will now offer a solution to the problem given out December 3, which, as will be remembered, is the application of the movement constituting the first problem given out to the propulsion of the shuttle-carriage of the celebrated Lyall's positive motion loom.

In the diagram, Fig. 2, $a\ a$ represents the lay-beam of a power loom attached to and oscillating on the rocker arms $b\ b'$, the shaft c performing the function of a pintle, and also turning freely in the bearings $d\ d'$ in the lower extremities of $b\ b'$. The pulleys $e\ e'\ e''\ e'''$ are supported on stud-pins inserted in brackets, extending downward from the extremities of the lay-beam. Similarly the pulleys or sprockets, $f_1\ f_1\ f_1''\ f''$, are supported on stud pins inserted in brackets, extending literally from the lower parts of the rocker arms $b\ b'$. Over these pulleys extends the endless chain or belt $r\ r$, indicated by a dotted line, and this belt also extends over the midwise pulleys or sprockets $g\ g'$, g' being the driver. The driver-sprocket is driven by the bevel gear k splined to the shaft c, and meshing into another bevel gear h fastened to the face of the spur-wheel m, this spur-wheel driving the spur-wheel r, formed in a single piece with the sprocket wheel g'. The frame o that carries this gearing is supported partly by the shaft c, that turns freely in bearings formed in the frame, and partly by the rigid rod p. The slide is shown at q, and

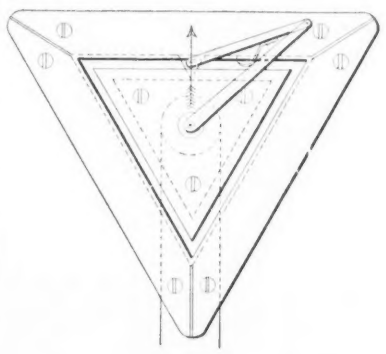


Fig. 1.

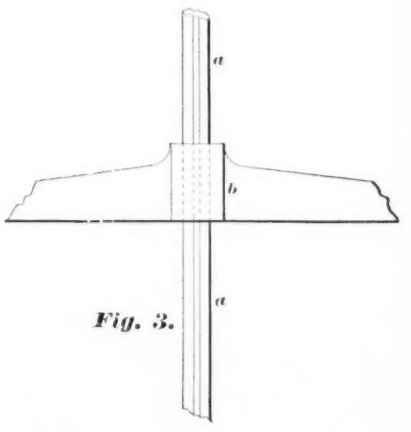


Fig. 3.

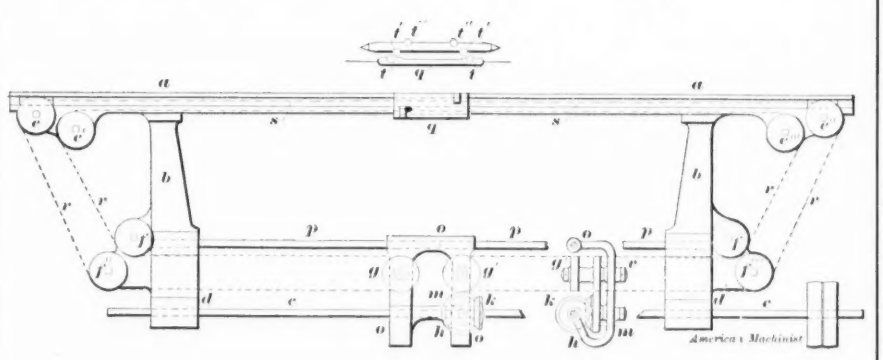


Fig. 2.

CULTIVATION OF THE INVENTIVE FACULTY.

it should be made of as light material as practicable. This slide is the shuttle carriage, and as it is to replace the shuttle carriage g' of the Lyall positive motion loom, it should have attached to the top the rollers $t\ t$, between which and the rollers $t'\ t'$ the lower threads of the shed in the warp are passed in the Lyall shuttle motion.

In this very ingenious invention, as it may, perhaps, be necessary to explain to those not familiar with it, the shuttle carriage g is now drawn to and fro by cords attached to each end of the carriage. The shuttle n is held in relation with the carriage by a guide on the lay-beam, against which the rollers $t''\ t''$ roll, bearing against the under side of the guide, and also rolling upon the under side of the series of threads of warp forming the upper part of the shed. As the shuttle is thus prevented from escaping from the carriage g', it is compelled to move with the latter.

In the solution of the application of the movement proposed, of course the lay-beam will need to be designed with reference to the provision of such a guide as described, and also for the support of the reed. I have not thought it needful to go into these details; the problem, as given, extended only to the propulsion of the shuttle carriage.

Of course, the shaft c must be supported in suitable bearings, not shown in the diagram. As the lay-beam is rocked on this shaft as on pivots, the frame o rocks with it, and this will generate a slight irregularity in the rotation of the spur-wheel m, and, as a consequence, in other parts of the movement, also, but the terms of the problem allow this slight variation.

In Fig. 3, I illustrate another problem. In that diagram a represents a vertical rotating shaft, to which the hub b is splined, so that both rotate together. It is required to supply mechanical devices that will so actuate the shaft and hub that, at stated uniform intervals, they shall execute the following movements, with alternating periods of rest.

First, after each period of rest the hub is to be slid upward on the shaft a definite distance, and remain at rest in that position a definite period of time, at the expiration of which both the shaft and the hub must be horizontally rotated a specific distance, less than a quarter circle, and when this rotation is finished the hub is to be lowered, without rotation, to the height it occupied at first; these movements and rests to be repeated indefinitely in the same order.

In the solution of this problem any known or new mechanical devices may be used, but the entire number of mechanical elements must not exceed fourteen. By the word "*element*" is here meant a distinct mechanical movement, that would be operative if used by itself for some other purpose.

I will add that this problem is one that has presented itself in my own practice within the past two years.

A Pleasant Occasion.

The Keuffel & Esser Co., of New York, recently celebrated its twenty-fifth anniversary by giving to its men and their wives and children a holiday at Oriental Park, in New Jersey. Everything was free, and the men were highly pleased on the occasion. One of them is reported as saying:

Our firm will lose nothing by their good will to us. Every one of us will try to increase the firm's business by every effort in his or her power, men and women alike. We are all paid to-day, although we do not work.

W. D. Howells says that whenever he has given way to so-called inspiration and "dashed off" a lot of work, he found next day that it was simply "rubbish." That's how a great writer differs from the youth who writes for the papers. The latter never finds it out.

This is another way of admitting that "genius" is an expression for a capacity for hard work, which just about sizes up the whole matter.

Cogging Wheels.

BY JOSEPH HORNER.

II.

A bevel mortise wheel is shown in Fig. 8 (page 6). In this figure the left-hand half section is that of the casting, the right-hand that of the pattern. The pitch line A and the tooth section B are seen dotted. The faces a and b are at right angles with the pitch cone $A\ C$. The distance C is equal to 0.3 the pitch, as noted in the previous paper, and the face d and the inner face of the rim e taper to the apex C of the cone.

The rim is built up in segments, similarly to the rim of a spur wheel. The section of the rim when built up, before any turning is done, is shown in Fig. 9 at A. To insure that the courses of segments shall each hold up to dimensions, the wheel is drawn out to full size, and the thickness of the courses also marked upon the drawing. The templates by which the rim is turned are also made by the drawing, so that there is no difficulty in insuring that the bevels of face and back and edges shall be correct. I need not show this in detail, but one illustration, Fig. 9, at B, showing how the face is turned to template, will render sufficiently clear the essential methods adopted in all work of this class. A straight-edge a is held across the edge b of the wheel already turned true, and the template c cut to the angle d, which the face e of the wheel makes with the line f, is the guide for turning the face by. The outer edge and the back are turned afterwards, when the wheel has been re-chucked.

The arms C, Fig. 8, are locked together in the way illustrated and described in connection with the spur wheel in a previous paper, but they are not usually recessed into the rim, as in the case with spur wheels. They are fitted with butt joints within the rim, but being fitted to a beveled surface, they are not so liable to become moved by rough usage as if they were fitted within a spur wheel. A couple of screws, driven in askew through the end of each arm into the rim, is nearly sufficient. In addition, however, there are two hollows f to each arm, glued in the long way of the grain, and these, being glued to both arm and rim, add very much to the security of the arms.

The boss D and the vertical arms E are not fastened to the flat arms, but are made to lift loosely away from them in the cope. The arms and boss are united in one of three ways: First, Fig. 10 A; the arms are locked together essentially in the same fashion as the flat arms described in the first paper, except that they are locked edgewise instead of flatwise, and the boss is fitted between them in segmental portions. The boss is turned and the six segments cut from it, and glued in the angles of the arms. Second, Fig. 10 B; the boss is turned and recessed in six places to receive the arms, which are glued into the recesses. Third, the arms are simply fitted against the boss and screwed or nailed to it, and the hollows or fillets glued in subsequently assist to keep them in place as in Fig. 8. This is a poor method. The first method is the best for large wheels; for small wheels in which the arms are not of great length the second method is sufficiently good.

The prints g for the mortises, Fig. 8, are not made and put on in precisely the same fashion as in the spur wheel. They do not come higher than the top of the mortise (see the enlarged view, Fig. 11), and their top ends are chamfered off in such a way that they will deliver from the mold when the wheel is lifted vertically. Moreover the width of the print follows the taper of the mortise precisely. A little taper outwards is given to the sides of the print, in addition to the taper that corresponds with the mortise, to assist free delivery. Also the prints may be thinner than those of spur wheels, because the cores are supported mainly on their faces instead of on the bottom end only, as in the case of a spur wheel, in which with a too narrow support the core would be liable to crush or press down the sand. These several points are clearly shown in Fig. 11.

The core box is shown in Fig. 12, and a core in Fig. 13. In this box, as in that for the spur wheel, entire provision is made for taper corresponding with that given to the prints, so that there is no filing to be done to the cores, nothing, in fact, except to blacken and drop the cores in their prints and close the mold.

The proportions given to the rim, and the taper in bevel mortise wheels, are similar to those employed for spur wheels; but the dimensions are taken on the large diameter of the wheel, and diminish towards the small diameter in the same proportion as the tooth dimensions. This is seen in Figs. 8 and 11.

Working Steel.

BY B. F. SPALDING.

When a cutting tool breaks or its edges crumble, it is pronounced "too hard"! It makes no difference what kind of a tool it is—an axe, a lathe, or planer tool, or a razor—if it loses its edge by fracture when it is called on to do its usual work, it is decided at once that it is "too hard"! This is always an error. There is no such thing as a cutting tool that is too hard. I might go even further, and say that there is no such thing as getting a spring too hard, but that is foreign to the purpose of what I am writing about. There might be some question as to whether there could be any elasticity in a substance that didn't "give" a little bit, but there can be no question whatever of the proposition that perfect hardness is the most desirable quality a cutting tool can have. What makes tools break if it isn't because they are too hard? Simply because they are too brittle, for this reason and no other

You can scrape bone or wood with glass, and the glass is not too hard—the edge doesn't crumble. Now try to scrape iron with it, and where does the edge go to? Is the glass too hard for the hard iron, and not too hard for the soft wood? By no means! for steel not as hard as the glass will scrape iron without crumbling. Now harden the steel over, and, while you are about it, take pains to heat it a little too hot, and you find the edge crumbles like glass. What have you done to it to make the difference? You have made it more brittle.

How have you made the steel more brittle? You put it into a fire that was hotter than unprotected steel will bear to be heated, and you watched it until it was nearly white-hot, and kept it at that heat, with access of air a few moments, and then you cooled it in water. That is what you did. Now what did the fire do, and what did the air, and what the water?

I have heard old English steel makers talk. I remember what one said to me but a short time ago. He had just had his helper lift some crucibles of melted steel from the furnace. "It makes me laugh," said he, turning around to me, "to hear the blacksmiths in this country talking about 'burning steel,' and that it mustn't be heated more than a cherry-red!" Here he expressed his jocularity by a short laugh, and continued, pointing to one of the glowing crucibles: "Don't you know that when that steel is poured the ingot will be full of little holes—air holes, some call 'em—and how are you going to make the bar solid if you don't weld it up? You've got to heat the ingot hot enough to flux, and then hammer it hard enough to drive the sides of those air holes down close together—quick, too; they won't weld if they are dry, any more than two pieces of dry clay. You've got to wet the clay to make it stick, and just so you've got to make the steel flux to make it solid."

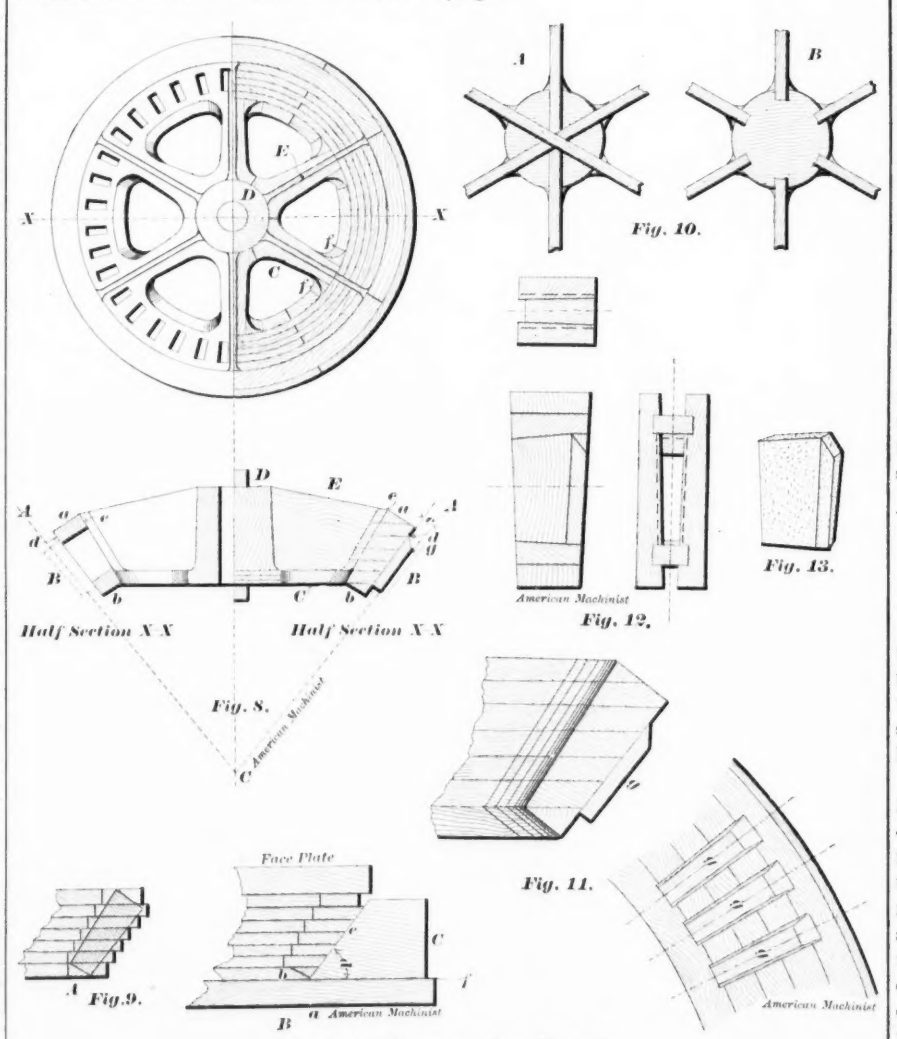
I have seen cast-iron retorts, seven feet long, kept red-hot for three months at a time, and when they were cooled and taken out they were seven feet and eight inches long. Where did the extra eight inches come from? The retorts grew longer in the fire! What did they grow on? "Upon what meat did this our Cæsar feed?" It certainly didn't improve its substance any, for I know that a junkman, who coveted and bought a lot of them, couldn't be induced to make a venture on another lot.

I have seen a bar of wrought-iron that was originally fitted to the mouth of a furnace, and in that place got heated red-hot many times a day, and cooled off as often, for some years, and it kept a growing until it was a foot longer than it was at first. What did it grow on?

The retorts grew because carbon and oxygen found their way into the interstices of their material and united with the iron, and the oxides and carburets occupied more space than the clean metal, and the whole retort grew in proportion to the growth of its millions of atoms.

The wrought-iron grew more, because every time it was heated it got bent, and then straightened, and every time these deflections occurred it became elongated, and this was in addition to and assisted in the lengthening out caused by the oxidation of its substance.

Now you may suspect that the fire and the air had this same effect upon your piece of steel. It changed the particles of pure steel to crystals of oxidized carburet of iron, and, by cooling in the water, little diamond points of combined carbon and steel were fixed, but



COGGING WHEELS.—SEE PAGE 5.

fixed so loosely in this crystallized framework, that when you scraped the iron, and they caught hold of it, the weak framework that held them broke down, and they crumbled out.

But if these disastrous effects followed the heating of the scraper in the open fire, how about the steel ingots that are heated so hot as to flux? In the first place, they are not unprotected; they are heated without access of air, and they are not only heated hot enough to produce a fluidity of surfaces, but they are hammered while all the impurities are in a free moving condition, and if you should see what came out of them you would suspect that everything was driven out by the force of the hammer blows, except the pure steel. The brittle framework was crushed, and all that constituted it was squeezed out in slag and cinder. The bar which has resulted from the process has grown smaller instead of larger; its specific gravity is notably increased; its weight is as much less as the weight of the injurious constituents it has got rid of.

Cast-steel used to be made by melting down blister-steel. Blister-steel was produced by the process of cementation. Bars of the purest wrought-iron which could be procured were packed in pure charcoal in boxes, and heated for some days until they were carbonized clear through, and when they were taken out there were blisters on the surface, which gave it its name, and they had gained in weight by the amount of carbon they had absorbed, less the weight of scale. The process of cementation only put the carbon into the iron, while the melting and casting made the metal homogeneous. Of course the outside of a bar of blister steel would be more carbonized than the inside, but when it was all melted together it was all alike. Other processes are in vogue at the present time which produce the same results without so much circumlocution. But just as good axes could be made, and were made with blister steel as could be made with cast-steel, and the steel was thoroughly welded together when it was welded into the iron to form the bit. The blisters had about the same relation to this steel that the air holes have to the ingot, and the blacksmith's hammer was capable of welding them firmly together, just as the big trip-hammer or steam hammer welds up all imperfections in the ingot.

What does all the talk amount to about the damage done to steel by upsetting it? Just this: These air holes are some of them larger, and some so small as to be almost imperceptible, but if one is no larger than a pin-head in the ingot, and the ingot is drawn down to an eighth of its size, the pin-head hole, if not absolutely welded, is become a little seam an inch long; now if you upset the bar, the direction of the seam changes, and it deepens; moreover, although the texture of steel although held to be granular, is, nevertheless, inclined to be fibrous, from the fact of the elongation of the bar in drawing out the ingot, and therefore upsetting causes a loosening of the texture by a separation of the fibers. But if the steel is first-rate, if either it has been made from a close ingot, or it has been absolutely welded, it can be upset—as many thousands of pieces have been—without any perceptible injury, either before or after hardening.

I don't believe that one half of the disasters which take place in hardening, which are laid to the fault of the blacksmith, are things which he is responsible for. In the first place, the whole system of having one man forge a piece of work, another man finish it, and still another man harden it, is totally subversive of all interest which a man ought to take in his own work. What does the man that hardens it know about what bar of steel it was made from? or, for that matter, what does the man that forged it know about it by the time it is finished? Perhaps it has lain in the tool room six weeks—or months. It makes me very tired to see the advice that is given by writers to harden a few pieces off from the bar, as test pieces, to determine the quality of the steel and what degree of heat to give it to get the best results, when I know how impracticable that proceeding is in any shop run on modern principles where any variety of work is done. Let the forger have a mark to set on each piece, and it will be turned off before it gets to the temperer, and then what good has it done? And even if the finisher restamps every piece, what a book of record would have to be kept between all the forgers and temperers! The idea is not feasible. But it is practicable to have steel workers who know their business do their work according to the best generally known principles of the art.

These principles should be kept in mind. Perfect hardness, perfect tenacity and perfect shape unite in a perfect tool. Aim at these, and if you can't hit them come as near as you can. Steel tools cannot be too hard; if you can't work the steel to take the brittleness out, try at least not to put any more in. Proportion your blows to the effect which they can produce according to the softness of the heat and the size of the piece. When you upset, be sure to get big enough to finish off surface checks after hammering. Don't hammer too hard on blood-red steel to strain it. Be tender with steel at a blue heat; that is its most delicate thermal point; anneal very carefully, casting the scale; cool the thickest parts first in hardening in water; if this is not practical, harden in oil; protect thin parts in heating; harden at the lowest sure heat.

LETTERS FROM PRACTICAL MEN.

An Arbor.

Editor American Machinist:

Some time since an incident occurred in a first-class shop to a job which a first-class tool maker had in process of construction which puzzled him to account for. Perhaps some of your bright correspondents would like to try a hand at it.

The job was making a common steel arbor, having hardened ends. The arbor was about 4½ inches long and intended to finish for ⅝ inch holes. He cut off his piece in the cutting off lathe; he then centered, drilled and reamed to a proper diameter the centers with a standard 60 degree reamer; then he turned up to a proper length and diameter each end of the piece for the dog to be used on in the ordinary way, and "barked" the intermediate space of arbor; next he went out to the smith shop and hardened the ends of arbor; came back to his lathe, examined the centers to make sure that all was right, namely, that the live center was true, and that the dead center was in good order; he then turned up the intermediate part of the arbor to within a small limit of size, leaving enough to finish in the grinder—a Brown & Sharpe machine—in good order. When he went to grind it to size, he found that it did run true on the dead centers of the grinder; but as the limit left to grind was enough to grind true, he completed the job by grinding it to correct size. When he returned to the lathe it was found to "run out" on the centers of the lathe, the live center being at rest. Why would that arbor not run alike on the dead centers of the lathe as the grinding machine?

Where did the trouble exist, and where did it originate? Let your correspondents tell us. FRANCIS W. CLOUGH.

Springfield, Mass., June 18, 1892.

Finishing Thimbles.

Editor American Machinist:

I have just read J. C. B.'s second question and your answer to it. I would not advise him to do as he suggests. We edge them off after tapering on an edging chuck, Fig.

1; in an edging lathe which is a double-spindle lathe, one spindle is operated with the foot and drawn back with a spring; it has an end movement of about 6", and a piece of wood, Fig. 3, driven in, turned to suit the work. The chuck, Fig. 1, is cut like an end mill, to help drive the work; the tool is a left-hand side tool, or a tool like Fig. 2, according to the amount of stock to be removed. We do about 8,000 shells per day, and pay about 3¼ cents per gross.

WATERBURY.

A Good Center Tool—A Rapid Way of Cutting Wire—A Home-made Speed Indicator—American Boasting.

Editor American Machinist:

In Fig. 1 I show the most satisfactory center tool I have ever used. I do not show this as a brand-new form of lathe tool, but as a good one that is not as generally used as it should be.

If you wish to re-center a piece of work, so that it will run *exactly* as on the original centers, with the end running in a "steady rest," you can bore out the countersink with this tool in a very satisfactory way.

It is useful for starting drills correctly, and is way ahead of the makeshifts usually used for the purpose.

In Fig. 2 I show a plan of cutting wire, which was shown me by a friend. In the sketch *A* is a heavy face-plate on lathe. *B* is the moving die, which is bolted to the face-plate as shown. *C* is the stationary die, which is simply a tool held in the tool-post of lathe, with a hole drilled through it to fit wire as shown, and hardened. The length of wire cut is the length die projects from face-plate.

In use, let the lathe run continually, and keep a steady pressure upon the wire, and so a piece will be cut at every revolution of spindle. I should suppose a heavy face-

Fig. 3.

FINISHING THIMBLES.

plate would be needed to store energy, and that it would be best to run the lathe on an "open belt," to save the shock on back gears. If the wire is quite large, two or more turns of spindle could be allowed to each cut, and so give it a chance to get up speed.

In your issue of May 12th, Mr. Cary gives a plan for a makeshift for a speed indicator. In Fig. 3 I show another plan that I have had in mind for some time, thinking that, if I ever got into a place where I was "stuck" for the want of one, I would make one of this description, as it can be made in most any country blacksmith shop.

Good speed indicators are so cheap that I do not offer this one for any purpose except a makeshift.

Suppose we want to count the revolutions of a shaft making about 2,000 turns a minute. I should take a piece of ¼" iron wire about 25" in length, and cut a thread upon it the whole length, with say a die of 24 P. if that was at hand. I would then fit to it a nut, as at *B*, after which I would flat the ends of wire, and form them into the spear points as shown, and then case-harden them.

I can make the wire turn the same as shaft to be counted by pressing the spear point into the center in shaft, as is common; this will screw the wire through the nut, and the nut in going 24" on the wire will count 576 turns, so if you notice the length of time that it takes for the nut to go the length of wire it is an easy matter to reckon its speed.

Next time the tool is used it can be reversed to screw the nut back.

Mr. Sweet says he saw work that was done in foreign countries that no American could do, or even tell how to do. I think it would be about fair if Mr. Sweet would show in the AMERICAN MACHINIST what this work is, so that Americans may know what it is that they can't do. Perhaps some will be foolish enough to offer a plan to solve the mystery; at any rate, it would be interesting.

A MECHANIC.

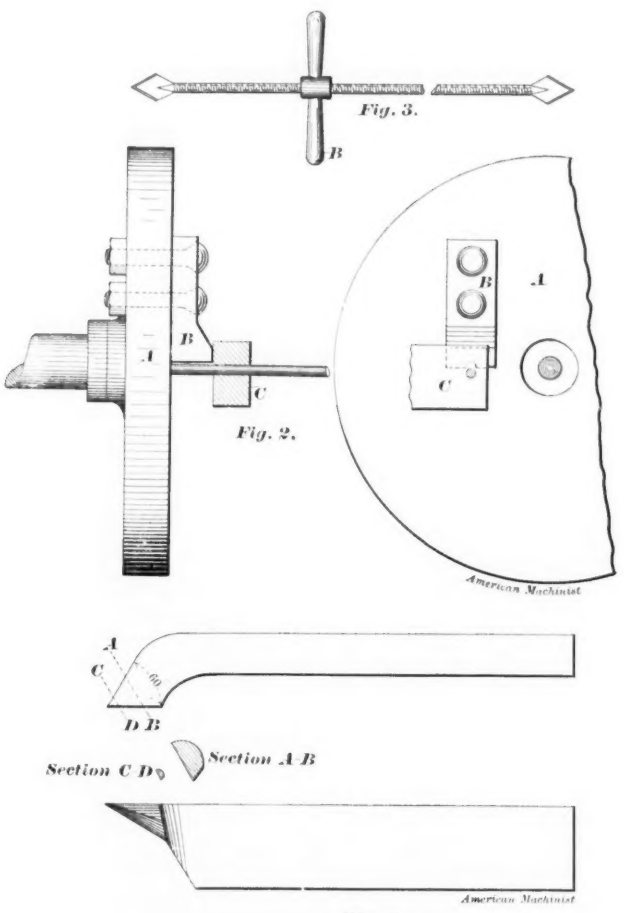


Fig. 1

A GOOD CENTER TOOL—CUTTING WIRE.

Pitting and Corrosion.

Editor American Machinist:

Regarding pitting in boilers, I read with interest Mr. Booth's remarks in your issue of June 30th.

It may be stated that the most dangerous form of pitting is that under sulphate of lime scale. Right here it may be well to plainly define pitting as distinguished from simple corrosion. For example, bad feed-water—say from some coal mine—often causes corrosion pure and simple, and this is quite different from the marks of pitting. The latter is shown by a depression generally circular in shape, and generally deepest at its center. These pits may be filled with black oxide of iron, red oxide of iron, scale, and ofttimes are simply empty. These pit-marks may vary from $\frac{1}{16}$" to 1" in diameter. When the marks are found on the side of a tube, drum or shell, they are often elliptical in shape.

While pitting is, of course, a form of corrosion, yet the two are usually separated in name, because of the difference in the shape of the attack. Usually corrosion attacks metals as a sulphuric acid bath would, though in some cases it runs in grooves, or, starting in at some particular point, may spread and destroy the sheet. Pitting differs from this in that the pit-holes tend to get deeper without spreading out of its circle, around which is good metal not affected.

Regarding Mr. Booth's thought of alkaline water in proper amounts being a preventive of pitting in clean boilers, I would say that I have no evidence to offer to support or reject his theory, for I have no data at hand, bearing on that point, that could be accepted as conclusive. However, I know of experiments in that line now being tried that I shall follow with interest, and in due time report. But I beg to differ from him on the theory he advances of "the scale keeps the plate hot, allows them to be exposed to the aqueous vapor generated in the scale next the plate, and that the action of the hot plate upon this is the cause of the oxidation" (see article). Were this true we might logically expect pitting under sulphate of lime scale in all cases, whereas not one case of that scale in ten shows it. Further, it may be said the worst would then be found on the lower half of the shell sheets, when, in fact, it is usually the worst in the covered mud drum and upper tubes. Remember, however, I say *usually*, as my knowledge of it only convinces me of its erratic character, and I may next week find something new. But to-day I would say that Mr. Booth's thought is not proven by what evidence I have met.

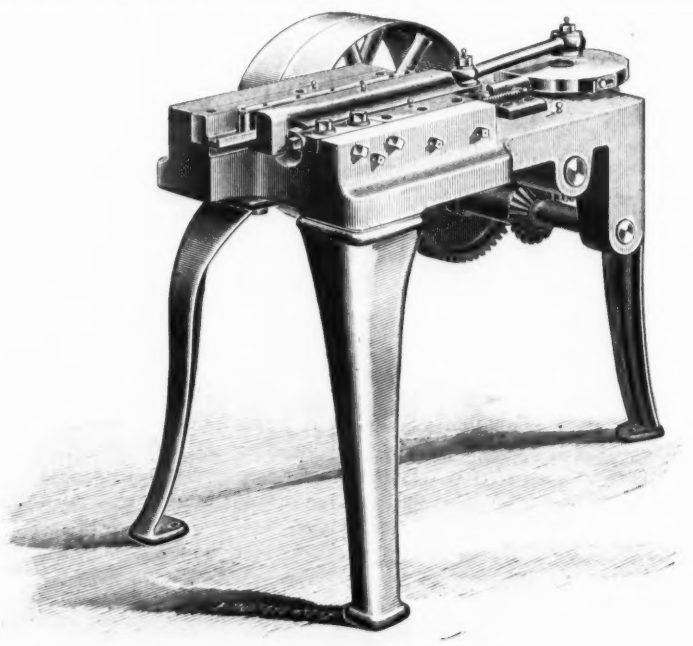
There may be certain conditions, when the sulphur leaving the lime and forming an imprisoned cell in the scale may attack the metal as dilute sulphuric acid. The porosity of the scale would allow enough water to be present to assist. This idea has some claims proven, and I put it forward for what it is worth. Have not proven it fully, and cannot at present. However, it would only apply to cases where sulphate of lime was present, and would leave me to guess at the causes where it is absent. However, I only advance it to show that I am not out of theories on the subject; in fact, can show up a dozen or so all about as tenable as this one.

In a boiler of the porcupine persuasion pitting was found in the mud drum. Acting under advice, the drum was cleaned and scraped, after which it was painted with graphite mixed with cylinder oil. Measurements of the depths of the pits were taken, and six months after they were found no deeper, and no new ones had shown up. Other parties have since tried this experiment in mud drums, but it is too early as yet to give the results. However, knowing the character of plumbago, if the interior of a boiler could be painted with it in such a way that it would stay, it may be this would prove a remedy. I am satisfied also that the person doing so would kill two birds with one stone, as the scale could be easily detached. The trouble is, however, to have such a paint stay where you put it.

In a pair of cylindrical boilers 42"x28', occasional applications of cylinder oil (mineral) and plumbago has kept back corrosion on a trial of six months. Boilers were new when plumbago was used. The boilers which the new ones replaced were thrown out rotten from corrosion. The feed was mine water, as nothing else could be had.

A preparation to use on a tubular boiler would, to be of value, have to adhere firmly, and even then its value as a specific under all conditions would remain to be established.

T. T. PARKER.



THREAD-ROLLING MACHINE

Thread-rolling Machine.

We present with this an illustration of a machine for rolling threads on the ends of bicycle spokes, and for similar light threading. In operation the wire is simply dropped into a slot, and is then rolled between two straight surfaces having grooves formed in them to shape the thread. No metal is cut away, the process being analogous to cold swaging, and the threads produced being very strong, smooth, uniform in size, and of good form. The tops of the threads made by this process are somewhat larger in diameter than the body of the wire, which also is an advantage in bicycle work, for the reason that the wire passes freely through the nipple in which the thread fits closely. The dies are readily renewed at small cost, and the entire machine is simple in construction and rapid in operation. Its weight is 800 pounds. It is made by Blake & Johnson, Waterbury, Conn.

The Jersey City Journal says: The colored porters on the "through" express train on the Erie Railroad who take care of the wash room and the vestibule curtains on the cars, other than the Pullman sleepers, are paid $40 per month. The Pullman Company, on the other hand, only pays its porters $15 per month for the entire care of a car, besides holding them responsible for soap, brushes and towels stolen and lost, and compel them to purchase two uniforms a year, all out of $15 per month.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.
Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, JULY 28, 1892.

CONTENTS.

	PAGE.
New Re-sawing Band saw Machine	1
The Rivett Bench Lathe	1, 2
A Proposed "Destroyer."	2, 3
Engines for the U. S. Battle-ship "Texas."	3
The Compound Engine. By Wm. H. Weightman	3, 4
Inside Micrometer Caliper and Depth Gauge	4, 5
On the Cultivation of the Inventive Faculty by the Solution of Constructive Problems. By Leicester Allen	5
A Pleasant Occasion	5
Cogging Wheels. By Joseph Horner.	5, 6
Working Steel. By B. F. Spalding.	6
Letters from Practical Men: An Arbor. By Francis W. Clough... Finishing Thimbles. By Waterbury... A Good Center Tool—A Rapid Way of Cutting Wire—A Home-made Speed Indicator—American Boasting. By A Mechanic.... Pitting and Corrosion. By T. T. Parker	6, 7
Thread-rolling Machine	7
The Angle of Countersunk Head Machine Screws	8
A Word Wanted	8
Ball Bearings for Street Cars	8
Questions and Answers	9
An Engineer's Ship of War	9, 10
Riveting Machine	10
Manufactures	10, 11
Machinists' Supplies and Iron	11

The Angle of Countersunk Head Machine Screws.

A correspondent who wished to know something about countersunk head machine screws asked us what the standard angle for these was, and if the size of the screw should affect the angle. Not being aware that any standard had ever been adopted for these, we addressed a letter of inquiry on this subject to the American Screw Company, of Providence, R. I., and received the following reply:

"In response to your request of 9th inst., we have pleasure in sending you herein illustrated sheet of machine screws, which shows the countersink of our standard goods.

"We are not prepared to furnish a list giving the figures of these angles, and hope the illustrations will be all that is necessary."

The sheet referred to contains engravings of standard screws made by the company, and the angles of the heads as there shown may or may not be accurate, depending upon how the engravings were produced. By our measurements of the angles with a protractor they seem to vary somewhat each way from 90° for the whole included angle, or 45° from the center line of the screw, and this is probably the nominal if not the exact angle. We also addressed a letter to the Hartford Machine Screw Company on this subject, and received the following reply:

"The recognized angle for countersunk head screws is 70 degrees, but there has never been an arbitrary rule, such as should have been adopted by all makers."

A similar letter was addressed also to the Worcester Machine Screw Company, of Worcester, Mass, whose reply is as follows:

"We are unable to say whether there is any standard angle for countersunk machine screws or not. When we started this branch of our business we took our angles from samples made by the American Screw Co. The angle which we are making our goo ls is about 75 degrees. This is all the information we can give you on the subject."

It will be noted that the Worcester Company's determination of the angle from samples of the A. S. Co.'s manufacture differs entirely from our results obtained from measurements of the engravings referred to, and by comparing the several replies it will be seen that there is plenty of room for reform here. There is some angle for the heads of these screws that is better probably than any other, and it would be advantageous to all concerned if there could be some agreement upon the matter. It is hardly in accordance with the modern way of doing things that these screws should be made of all angles, or that they should vary from some fixed standard, except in special cases. We hope to see the matter taken up and discussed.

A Word Wanted.

A very well-known engineer writes us as follows:

"Bodies are inert. Being stationary, power is required to move them. Being in motion, power is required to stop them. That thing which is to be overcome in making motion or arresting motion we call inertia. The body being in motion contains a force we call momentum. Momentum is therefore simply inertia at one end of the line. Momentum is inertia, but inertia is not necessarily momentum. The question is, what single word is there, in any language, which will express that quality of inertia, at the first end of the line, which resists motion? some word as specifically distinct for that end of the line as momentum is for the other end of the line. Inertia is the generic term, covering two specific things; we have a name for one of the specific things, and what is wanted is a name for the other specific thing."

The need of the term which our friend wishes to find has, we think, been realized by many of those who have attempted to master the theory of dynamics, or force and power. We all know that, in order to put a body in motion, energy must be expended It is not proper, according to the authorities, to say that this energy has been expended in overcoming the inertia of the body, but that it is merely stored up in the body, and will be given out again in bringing the body to rest. Inertia is often used in the sense of a measurable quantity, and as though a heavy body might have more inertia than a lighter one, which is incorrect. What seems to be wanted is a term which will express quantitatively the resistance of inert bodies to being put in motion. A little discussion of the matter might be useful, and we shall hope to see the matter taken up.

Ball Bearings for Street Cars.

There has been running on the Fitchburg street railroad for several months a car mounted on ball bearings, which have been in constant use and subjected to the severest tests, and examination now shows that not the slightest evidence of wear can be found on either the bearing surfaces or balls. The bearings were oiled with a few drops of oil at first, and have run ever since without being touched.—*Springfield Republican.*

The above is just the kind of stuff that tends to prevent the use of devices for reducing friction, or accomplishing any desired end in the line of mechanical matters. The wear of the constituent parts of machinery is not measured by "sticks" or picas; and, moreover, any mechanic, however much he may favor ball bearings, knows that there was wear of both journals and balls, and decently accurate measurements, as measurements are made to-day, would have shown this to have been true. When men start out to write of things of which they have no knowledge, they generally fail to impart information.

A sharp advance in the price of anthracite coal has been made for July, by which we suppose the anthracite coal road combination seeks to give to the people another illustration of the practical workings and effects of those "economies of production" which we are told is always the chief, if not indeed the only object of trusts and other similiar combinations. Every man, as he pays his coal bills, will have this great truth brought home to him, and it is to be hoped that the day is coming when sufficient numbers of them will be aroused to put an end to the possibility of such combinations. By the way, those who think they would enjoy the reading of a lot of "glittering generalities" regarding this matter might read President McLeod's article in *The Forum* for July, a sample of what is to be found in it being contained in the statement by him that the Reading system proposes to bring the products of its territory "home to the consumer upon surer and better terms." Now it is at once seen that this may mean anything. Prices are higher, and it is far more certain that they will remain higher than if the combination had not been formed; so that, so far, the terms are certainly "surer." Then there can be no manner of doubt but that the present high prices are "better terms," *for those who are in the combination*, though that, of course, is not what Mr. McLeod wished his readers to understand from his words. It is as Abraham Lincoln said, "You can fool part of the people all the time, and all of the people part of the time, but you can't fool all the people all the time."

We publish elsewhere in this issue an article taken from our London contemporary, *The Engineer*, in which the editor makes what will be recognized as some very clever hits at the modern naval vessel, which, it is very certain, needs nothing so much as reconstruction by engineers who are accustomed to first find out what is really desirable in any proposed structure, then what may confidently be considered possible of attainment, and finally what are the simplest, cheapest, most reliable and best means of accomplishing the desired ends. Ericsson's Monitor was "an engineers' ship of war," and we venture to say that another engineers' sea-fighting machine would, if built, make things about as interesting for the modern fanciful "scientific museum," as the Monitor did for the regular naval vessels of the sixties. It is almost absolutely certain that modern naval vessels are filled with things, electrical and other, that would be utterly useless after the first round was fired in a real battle, if not before.

We have received a bound copy of the first volume of *The Compass*, a monthly journal for engineers, surveyors, architects, draftsmen and students, edited by William Cox, and published by Keuffel & Esser Co., 127 Fulton street, New York. It is mainly devoted to the construction, care and use of the various instruments used by engineers, surveyors, etc., and much space is given to the use of the slide rule and other speedy calculators, showing clearly the amount of labor that can be saved by the employment of these simple instruments, and that implicit confidence can be placed in the results. Throughout the volume there are interspersed many short paragraphs of interesting and useful character, tables, and instructive solutions of various kinds of problems, the whole forming not only a neat, but also a valuable volume, which is a credit to its editor and publishers. Price, $1.75.

A correspondent asks us as to the rating of the navy of the United States as compared with other countries We cannot say as to this—perhaps sixth, or somewhere near there. It is hardly probable that this country will, at least not for generations, attempt to create a navy that will rank as first-class. It is not necessary.

This same correspondent asks us if there is an opportunity to sell to this government an invention relating to a new large gun that would be superior to anything yet made. The best probable plan for him is to patent his invention, if it seems really valuable, in different countries, and then make the best terms he can. Whether right or wrong, there is a prevailing opinion that the United States Government is not particularly inclined to favor home inventors in articles pertaining to war.

The New York World's Fair Commissioners have been trying to find a model of Fulton's steamboat, the "Clermont," to be included in the State's exhibit at Chicago. So far, however, they have been unable to discover one, and they have asked the Maritime Exchange to help them out. They have made many inquiries, but have been able to get only some statistics as to the vessel's dimensions. None of the New York shipping men appear to know if any model of the old steamboat survives the eighty years since the vessel was used.

We have received from the Consulate of Denmark, P. O. Box 2,212, New York, a circular stating in effect that the port of Copenhagen has been made a free port, and inviting traders and manufacturers to make the best possible use of it. This port very readily covers a large territory, and the facts stated in the circular are of undoubted importance to manufacturers. Further information, we have no doubt, can be had by addressing as above indicated.

The New York Times says: It is well known that Trust combinations frequently sell their goods abroad at prices lower than the prices exacted at home.

"Trusts" are not the only sinners, or saints, in this respect. The writer has found a difference of thirty per cent. in favor of the foreign consumer in the instance of rather staple articles of manufacture made in this country. These cases were in the instance of goods in which with the manufacture or sale no "Trust" had an interest.

It is said that in England there are what may be called schools for educating men up to stand the test for color blindness required by railroad companies. All there appears to be to it is that a man is taught to name the color, not as it appears to him, but as it really is. If he can be taught to name it right it would not seem to matter much.

The refusal of officials of large manufacturing interests and railroad officials to answer questions asked by the Interstate Commerce

Commission, on the ground that the answers would criminate them, is likely to lead to an interesting contest as to the constitutionality of the law creating such a commission.

It is expected that prospective exhibitors at the World's Fair will soon be furnished with a comprehensive rate of freight tariffs that will prevail during the exposition.

The New Jersey coast is being encroached upon to such an extent by Mother Ocean that an engineer has been sent abroad to study up methods of protection.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(306) G. W. M. Co., Chicago, write: We want to case-harden a lot of shafts 1½"x21", C. R. steel. Can you give us any information as to furnaces, boxes, materials and methods? *A.*—You will find information on this subject in articles by Mr. B. F. Spalding, in issues of June 23, 1888, May 22, and June 5, 1890.

(307) M. S., Ensival, Belgium, asks: Why are the flutes of reamers not spaced evenly, and why are some of them not of the same depth as others? *A.*—They are spaced unevenly to avoid chattering or the formation of ridges in holes reamed, and the varying depths result from this unequal spacing, all the flutes being cut with the same form of cutter, and the extreme top or "land" of the flutes being of uniform width.

(308) G. G. L., Hoboken, N. J., writes: Please inform me where I can purchase a book relating to the preparation for etching glass. *A.*—Write to any dealer in scientific books; the addresses of some of them are given in our advertising columns. 2. Where can I get the best guide to all places of interest, and a good map of New York? I am a stranger here. *A.*—In any good stationery store, of which there are a number in your vicinity.

(309) A. M. G., Germantown, Pa., writes: Kindly give me the name of a book that treats on shop practice, such as sharpening of tools, setting, depth of cuts, feed, etc. *A.*—"Modern Machine Shop Practice," by J. Rose. 2. In one of your answers you stated that a ball 2 inches diameter is twice as large as one 1 inch diameter. Would it not be eight times as large? *A.*—No, it is twice as large; but the weight of large one is 8 times that of the smaller one.

(310) G. S., Milano, Italy, writes: Please give me the name of a practical treatise relating to ventilating, drying and cooling with disk fans. Please give price of the book. *A.*—We do not know of a book that is wholly devoted to this subject. The Buffalo Forge Co., of Buffalo, N. Y., and B. F. Sturtevant, Boston, Mass., issue catalogues which contain much useful and practical information, and these may be of great aid to you

(311) Sand, Brooklyn, N. Y., writes: Can you direct me to any literature bearing on the subject of molding sand, with special reference to the qualitative and quantitative chemical composition of the different sands and the practical effects of changes in the proportions of the various minerals which compose the sand? *A.*—The mixture of sands for foundry purposes is given in "American Foundry Practice," by Thomas D. West; also in "The Iron Founder," by Simpson Bolland; but we have not seen a book that treats on the chemical properties of sand.

(312) J. S. R, Philadelphia, Pa, writes: Inclosed please find sketch of a spiral spring (not helical). Please give me a rule through your columns for computing its strength in pounds for a given size of steel and a given number of turns and space between coils. Also give rule for computing the size of and number of turns for a given load. *A.*—We have not been able to find a formula for computing the strength of this class of springs. Inquiries among spring manufacturers seem to indicate that the strength of these springs is obtained by experiments.

(313) R. W. K., Pottsville, Pa., writes: I notice in one of your issues that iron has been rolled to $\frac{1}{1800}$ of an inch thick. I would like to know whether there is a manufacturer at present who supplies iron of even $\frac{1}{1000}$ of an inch in thickness. If not supplied, what are the principal difficulties in the manufacture of such thin sheets? *A.*—There is no difficulty in manufacturing sheets of this thickness, excepting that it does not pay to roll small quantities at a time. Nearly all the mills that manufacture plates can furnish these, if the demand is a paying one.

(314) G. D., New York, asks: How do manufacturers that make taps smaller than ¼" get their sizes for such as No. 2, 3, 4, 5 and on up to 30? Does some one make a standard gauge? *A.*—You will find a table and formula for the size of machine screws in our issue of Aug. 18, 1888. The taps will be made enough larger to allow for wear, and for screwing in the screws easily, according to judgment. Gauges for the screws are in the market, and can be procured at the tool stores. 2. What is the standard gas pipe thread? *A.*—You will find this matter fully treated, and a table of sizes and numbers of threads, given in our issue of April 9, 1891.

(315) B. H., Buffalo, N. Y., writes: Please inform me through your columns where I can get a good book which explains the manufacture of malleable iron and steel castings in a small way. *A.*—The literature on this subject is very unsatisfactory. "Iron and Steel Founding," by C. Wylie, devotes only a few pages to this subject, but a complete modern process is not given. "Appleton's Cyclopedia of Applied Mechanics" gives a short outline of the process, and there are other books which devote a chapter or less on the subject. We believe the only way to get reliable information is by experience in a foundry fitted up for this class of work, or engage some one who is thoroughly familiar with all the details, as it requires skill and experience to produce good malleable and steel castings.

(316) "Cone," Philadelphia, asks: How are the back gears of lathes proportioned relative to speed cone, and by what progression are the steps of the cones made? *A.*—There is no fixed rule for this, many lathes having back gears proportioned 5 or 6 to 1, while others are as much as 9 or 10 to 1. The steps of the cone are proportioned simply to give a regular gradation of speeds between the fastest and slowest, which latter speeds are determined mainly by the exercise of good judgment and experience. The slowest speed should enable iron or steel to be turned of a diameter equal to the full swing of the lathe. There should be about or nearly the same relative difference of speed between the slowest out of gear and the fastest in gear, as between any other two speeds. Observe other lathes of approved construction and count the different speeds.

(317) E. H. C., ——, writes: It has been the custom in the different shops where I have been employed, in balancing pulleys to use shafts of the same diameter as the bore of the pulley. But where I now work they use a shaft one-half as large as the bore. For instance, for a pulley with a 6" bore they would use a 3" shaft. Please inform me what advantages this plan has, if any, over the old way? *A.*—We have never had any experience with this plan, but, so far as we can see, it has no advantage except that of not requiring a shaft or arbor to be fitted and driven in. We can see no particular virtue in having the shaft one half or any other fixed proportion to the bore. Probably any shaft somewhat smaller than the bore would answer the same purpose. If there is anything more than this in the matter, we should be glad to hear from some of our readers who have had experience with it.

(318) J. F. B., Hudson, N. Y., writes: Kindly advise through your Question and Answer columns in regard to the following: We have in our mill an upright shaft driven by a water wheel at the bottom, besides larger gears on the same shaft. There is at its top a small bevel gear driving a larger one to turn another line of shafting, etc. For some reason there has always been more or less trouble with these gears, and we would like your opinion as to the practicability of driving the second shaft by means of a pulley and a quarter-twist belt. *A.*—This can be done, but you will need an extra countershaft unless you can shift the horizontal shaft to some distance from the vertical one. This arrangement will not be as compact as the present one, but it will do the work. It seems to us that you should not have any trouble with the present arrangement if the wheels are correctly constructed, the bearings properly distributed, and the whole put in good alignment.

(319) L. P. L., Newton, Kan., writes: I wish to build a gas engine and would be pleased to have the following question answered: 1. Does gas expand as it follows the piston after it is exploded? *A.*—Yes. 2. Would I gain by putting in two pistons traveling in opposite directions, the gas exploding between them? *A.*—No. 3. Which would be preferable—a horizontal or upright engine, lubrication considered? *A.*—Lubrication will not determine the choice between these two types. 4. About how much power will I get from a cylinder 4 inches diameter by 4 inches stroke, or would you advise other proportions? *A.*—The horse-power will depend on the quality and quantity of the explosive mixture. We should prefer a longer stroke. 5. Is electricity the best medium for igniting the gas? *A.*—Some builders prefer it. It is difficult to decide which is the best medium. 6. What is the durability of gas engines in general, in comparison with steam engines? *A.*—Gas engines are as durable as steam engines. 7. Please name some authority on gas engines. *A.*—"The Gas Engine," by Dugald Clerk.

(320) R. W. W., ——, writes: I am in a plate-mill and am called upon to figure the weights of different sizes of plates varying in thickness, and I would like to know if there is any way of arriving at the results graphically, instead of using figures. Example: What is the weight of a steel plate (taking 490 pounds per cubic foot) $\frac{7}{16}$ inch thick, 16⅜ inches wide and 89½ inches long. If you can put any light on this subject you will oblige. *A.*—We believe it can be done. You will find all these graphical methods explained in "Graphics, or the Art of Calculating by Drawing Lines, especially applied to Mechanical Engineering," by R. H. Smith. We have never tried it, because we believed that for such simple problems there is no more practical utility in its use than there is in using logarithms for simple addition and subtraction. From this it must not be understood that we do not favor graphical methods; indeed, these are almost indispensable for the solutions of complicated problems. It seems to us that a good slide rule will be of great service to you. It will require practice to work it quickly and accurately, but after you have become proficient in its use you will not regret the time spent in practice.

(321) J. R. C., San Francisco, Cal., writes: In case of a compound duplex pump, high-pressure cylinder 12 inches diameter, low-pressure cylinder 18 inches diameter, working non-condensing, A. claims the net work is equally divided between the high and low-pressure cylinders under all pressures of steam. B. claims that it is not, and that at certain pressures the high pressure cylinder does more work than the low-pressure, and at other pressures the conditions are reversed. *A.*—B. is correct. 2. B. claims that the following formulas are correct, clearance and condensation being neglected.

$$\frac{\text{Volume of L. P. cylinder}}{\text{Volume of H. P. cylinder}} = \text{ratio of expansion.}$$

A.—This formula gives the ratio of cylinders, and not the ratio of expansion.

$$3.\ \frac{\text{Absolute steam pressure}}{\text{Ratio of expansion}} = \text{pressure in L. P. cylinder.}$$

A.—Not correct. The initial pressure in the H. P. cylinder divided by the total ratio of expansion gives the terminal pressure in the L. P. cylinder. The other two formulas are meaningless. 4. A. claims that in a non condensing engine the atmospheric pressure should not enter the calculation. *A.*—In all computations of pressures the absolute pressure should always be taken; the latter always includes the atmospheric pressure; therefore the atmospheric pressure is taken into account in all cases.

(322) A. B. C., Adrian, Mich., writes: Kindly let me know if there is any rule for taking the length of a pipe that is bent; that is to say, if I wanted to make an *S* bend or any other form, and as many bends in, say 18 feet, as may be required, can I obtain the length without taking a piece of wire of known length, then bending it to the correct form, and thus get the length of pipe? *A.*—The proper way to obtain the length of pipe is to make a correct drawing of its center line; of course this drawing need not be full size, but can be made to any convenient scale. If the bends consist of arcs equal to one-quarter of the circle the length of each arc is readily found by dividing the circumference of the circle by 4, the radius, of course, being established on the drawing; and if the arc is a semi circumference it is scarcely necessary to say that its length is obtained by dividing the circumference by 2. The length of arcs which are not equal to ¼ or ½ of the circumference of a circle can be found by the rule given in our issue of June 9th, page 2, current volume. Adding the lengths of the arcs thus found and the lengths of the straight portions, if any, will give the total length of pipe. If all the bends lie in one plane the total length is easily found sufficiently accurate for practical purposes by stepping off with the dividers a number of spaces of known length; the shorter these are the greater will be the accuracy; the product obtained by multiplying the number of spaces by the length of one space will be the required length of pipe. On account of inaccurate workmanship it is often very difficult, if not impossible, to make the pipe fit exactly in its given place without any adjustment; for this reason one flange should be left loose, so that it can be adjusted to its proper position when the pipe is put in its place.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Wheels, Gear Cutting, page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters Best in the market. Superior Machine Works, 106 Canal St., Cleve'd, O.

Pulley lathes, most efficient offered. Ohio Machine Tool Works, Cincinnati, O.

J. S. Thurman, M. E., Indianapolis, Ind., Expert Patent Solicitor. Inventions Perfected.

Corres with parties having special mach'y to build. Kollmyer & Talbot, Keokuk, Iowa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } Even if they come from Jersey."
42" } Gould & Eberhardt, New Ark, N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

"Modern Machine Shop Practice," by Joshua Rose wanted for cash, or in exchange for other mechanical or electrical books; send for our cat. N. W Henley & Co., 150 Nassau St., N. Y.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

An Engineer's Ship of War.

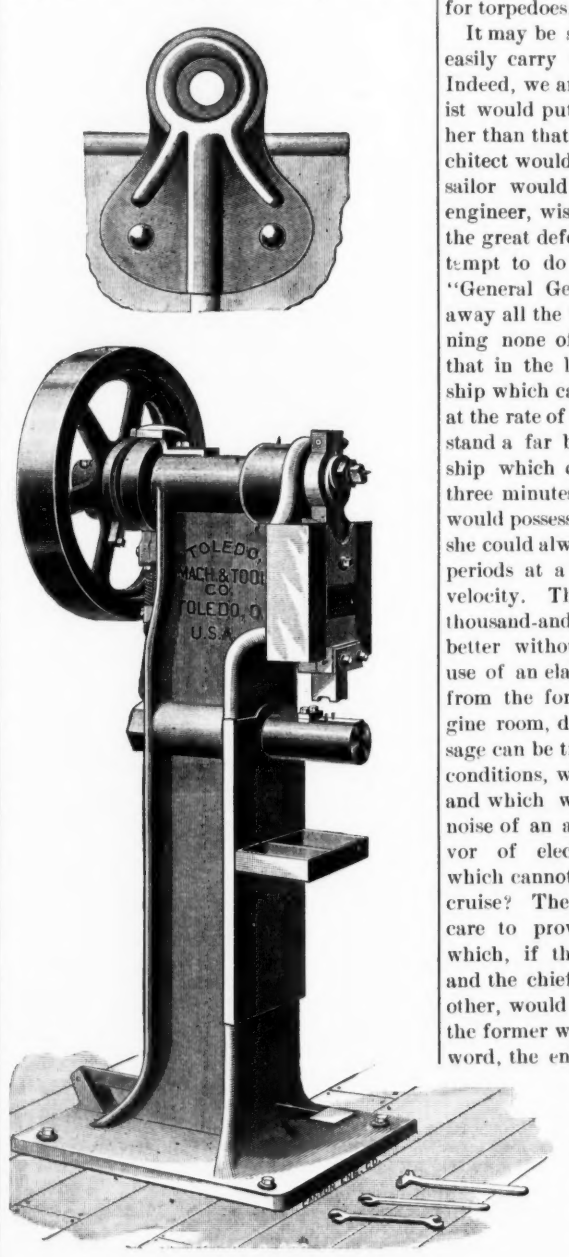
Miles of letter-press have been printed and published and read and discussed concerning the construction and qualities of ships of war. We cannot call to mind that any of these disquisitions, or treatises, or papers, or books have emanated exclusively from the brains of engineers. Of course, without the aid of the engineer the modern war ship could have no existence. But hitherto he has always taken a second place. He has been told to do this, that, and the other thing, and he has gone and done it; but little deference has been paid to any of his rare expressions of opinion. He has been told that naval matters are too hard for him, and that his true function consists in accomplishing the tasks set for him, and asking no questions. He is shown, for example, a very limited space on certain plans, and told to put engines and boilers into it which shall develop 10,000 horse power, or some other trifle of that nature; but he is not allowed to suggest that if he had a freer hand he could produce a better speed result, let us say, for less power. He is told that a gun is to be worked in a particular way, and that he must make the machinery for so working it; but he is not permitted to point out that the thing admits of being done better in another way. He is not snubbed exactly, but he has been taught to keep his own place, and stand, hat in hand, when the naval architect, the artillerist, and the sailor pass by. Considering how very important is the part played in a

compulsorily disjointed fashion by the engineer, we venture to think that he has not been treated quite in the way that he deserves, and we go so far as to ask, Is it not about time that the engineer took the initiative, and, reversing the normal practice, employed the naval architect and the artillerist to carry out *his* designs? We hold that there can be but one sound answer to this question, and it may not be unprofitable to consider in what way the engineer would probably go to work.

It goes without saying that he would come to the task of designing a fighting ship with a very fair knowledge of what has already been done, and with a mind quite free from prejudice. His first endeavor would be to produce an honest ship, a vessel quite free from shams of all kinds. What we mean by this will become clear as we proceed. It is of paramount importance that, whether a ship of war can do much or little, she must be able to do that much or little as well as it can be done. For example, she may be able to steam at twelve knots an hour, or at eighteen knots, or any intermediate speed. But whatever her stated pace, she must be able to keep it up for any number of hours without fear of a breakdown, and without exhausting her crew. In the same way she may carry a gun or guns of any given size, but they must be honest weapons, which may be trusted to fire away all the ammunition she can carry without bursting, or dropping at the muzzle, or playing any other prank. In the same way rapidity of firing must be regarded as quite subordinate to the certainty of being able to fire. Thus, for example, if there are two methods of working a given gun, and one means ten rounds in ten minutes, and the other means five rounds in ten minutes, the engineer will adopt the latter, provided the mechanism is simple, and sure to be worked with success in the heat and confusion and turmoil of action, when men's hearts beat fast, and their breathing is quick, and their hands shake, while the rapid fire can only be got by the aid of delicate appurtenances, requiring coolness and steadiness to work them without a breakdown. Want of space prevents us, of course, from doing more than hinting at the way in which an engineer would deal with the problem, but our engineer readers will be able to amplify for themselves as they go on.

A very early step in the process of solving the problem consists in settling how big or how small things are to be. We fancy that a ship with a displacement of about 5,000 tons will satisfy all the requirements of an engineer. He will be moderate in his promises, but then they will certainly be kept. As to the shape of the hull and her lines, these must be settled by the naval architect, acting under the general instructions of the engineer. The latter will be very careful not to try for too high a speed. About 16 knots will be the maximum aimed at, to be had with a forced draught pressure of certainly not more than one inch. If the ship has good lines this speed ought to be easily got with about 6,000 indicated horse-power; probably less would suffice. It must be very clearly understood that this 16 knots is the true sea speed of the ship, and not a fancy result got on a four hours' run, with picked coal and selected stokers. This is essential, because of the way in which the ships would be worked. There would always be three precisely similar vessels cruising in company. They would be as much alike as three Martini-Henry rifles. Every part of each would be interchangeable with any other of the three, and as the sea speeds of all would be the same, there would be no waiting for the slowest, and they could always keep in company save in the wildest weather. Three such ships ought to be able to give very great trouble to any one war ship of, say, 14,000 tons, although one alone would have to take to her heels. Once more the limits of space prevent us from enlarging on the merits of this multiple unit system of action, a system which can only be carried out when the vessels composing each unit are really identical.

The engineer would not leave his craft absolutely without armor. We have been told by more than one gallant admiral—somewhat late in the day, it is true—that it is quite impossible to hit a vessel with rifled shot anywhere near the water line; and, taking them at their word, the engineer would leave his ship without any belt; but, on the other hand, he would provide really adequate defenses for the numerous quick-fire light guns which she would carry on the broadside; and these defenses could be so contrived that the guns might be fought, although the upper works of the ship were involved in one general ruin. In like manner the engines would be protected. The engineer would make the machinery of the ship his first consideration, and he would not stint the engines in height. An armor deck to keep out shells, supplemented by coals, and



RIVETING MACHINE.

an armor trunk round what we may term the engine hatch, would make things reasonably secure. Too much could not be attempted. We come now to perhaps the most important feature in the whole vessel, namely her armament. The engineer has learned by this time that two conditions appear to be essential. The first is that the gun must be thoroughly trustworthy; the second, that it must be high out of the water. Now the way in which a ship of the kind we are sketching would be fought closely resembles the system adopted in old times by the smaller craft. They carried carronades on the broadside, perhaps five on each side, and forward a long brass 32-pounder. This weapon had considerable range, and was really the most powerful gun in the ship. We have only to read naval history to learn how such guns were used. The engineer would reproduce this system on a greatly enlarged scale. While 4 inches would be about the size of the largest broadside gun, he would mount forward an 8 inch quick-fire gun, weighing 14 tons, and competent to penetrate 16 inch of armor at 1,000 yards, and he would not hesitate to put an extra ton of steel into it to get strength. To mount this gun in a turret would never do. The engineer, as we have said, will have no shams on board his ship, and a turret that would really protect the gun would be much too heavy, and the gun would be kept too near the water. On the other hand a barbette, while very heavy, would scarcely supply adequate protection, and, as in the case of the turret, it would leave the gun too near the water. The way out of the difficulty lies in adopting a modified form of the disappearing carriage. The gun could then be fired from an abnormal height above the sea, and then returned to a place of comparative safety within a species of armored redoubt forward. All the arrangements would be suitable to the rough-and-ready handling which the weapon would undergo in an engagement; ample provision would be made for torpedoes.

It may be said that a 5,000-ton ship could easily carry two such guns instead of one. Indeed, we are quite certain that the artillerist would put a much heavier armament into her than that suggested, while the naval architect would put on more armor, and the sailor would put on more speed; but the engineer, wiser in his generation, knows that the great defect of all war ships lies in the attempt to do too much. They are like the "General Genius," who professes to carry away all the world's prizes, and ends in winning none of them. The engineer knows that in the long run, if there is fighting, a ship which can keep on shooting for an hour at the rate of a round every two minutes will stand a far better chance of victory than a ship which can fire a round a minute for three minutes only; but the engineer's ship would possess an enormous advantage, in that she could always be trusted to steam for long periods at a high, though not the highest velocity. There are in modern men-of-war a thousand-and-one details that they would be better without. For example, what is the use of an elaborate series of speaking tubes from the forward conning tower to the engine room, down which no intelligible message can be transmitted, even under ordinary conditions, when the engines are running, and which would be utterly useless in the noise of an action? What can be said in favor of electrical signaling arrangements, which cannot be trusted even on a peaceful cruise? The engineer would take very good care to provide signaling arrangements, which, if they did not permit the captain and the chief engineer to consult with each other, would not fail to tell the latter what the former wanted the engines to do. In one word, the engineer's war ship would be less of a scientific museum and more of a floating gun carriage. Her claims would be modest, but what she promised to do she could do. The story told by past naval maneuvers goes to show that the promises of the modern war ship are seldom kept, and this simply because more is attempted than the wit of man can carry out.—*The Engineer.*

It seems singular to have the establishment of the electric light on Mount Washington delayed by lack of power when the cheapest and freest force of nature is so plentiful there that the buildings have to be chained down. What is the matter with a wind engine?—*Manchester (N. H.) Union.*

Riveting Machine.

The accompanying illustration is of a machine designed especially for riveting the ears on tin or other metallic pails, though, of course, with suitable modifications, it would be equally adapted to any similar work.

In operation the two rivets used to fasten the ear are placed in a groove provided in the die, which is on the projecting horn; the pail and the ear are placed over them against gauges which bring them into proper position, when the first stroke of the machine punches the rivets through both pail and ears, after which, and during the up stroke, they are drawn toward the operator to spring stops, which are pressed downwards during the first operation, and the next down stroke, which is made without removing the foot from the treadle, upsets the rivets, and completes the job, as shown in the small engraving, the work being done much more neatly and uniformly than it is done by the usual hand methods, while a boy with this machine will rivet the ears on from 15 to 20 gross of ordinary small pails per day. The machine is built by the Toledo Machine and Tool Co., Toledo, Ohio.

A very vivid illustration of what is meant by the term "stored energy" was given by the steamship "Travè," which, steaming along at about eighteen knots, in a fog, suddenly encountered a sailing ship, and, before she could be veered off, struck and passed entirely through it, going two miles beyond before she could be stopped. It is probable that full speed may be safest for a steamer under such conditions, but it is certainly not safest for ships which she may encounter, as was shown in this case, and if the vessel met should happen to be a steel or iron steamship the result is, of course, different. He who can devise a method by which the presence and location of ships can be made known on other ships within a distance of say two miles, will confer upon navigators, and those who sail the seas, the greatest boon which it now seems possible to give them.

Sunday opening [at Chicago] has been urged for the reason, among others, that it would give a great many workingmen and their families a chance to visit the Fair which they would not otherwise get. As nobody was especially interested to discover the attitude of this class of people toward the subject, few statistics have been collected. One canvass, however, has been made. The International Iron Molders' Union, whose headquarters are in Cincinnati, have taken a vote of the local unions upon the Sunday opening question, and the result is three to one in favor, the vote standing 13,695 for and 4,585 against. This is doubtless a pretty fair test of the feeling among intelligent workingmen in all trades.—*The Evening Post.*

The Baltimore & Ohio Railroad Company is preparing a historical exhibit for the World's Fair, which will consist of a facsimile representation of the road-bed as originally laid down, which consisted in laying stone stringers with strap rail. Enough of the old rails have been unearthed and sent on to Chicago for this purpose, and the original "shanty car" will be shown on a track. The old locomotive Peter Cooper will be rebuilt in full size and displayed in connection with the modern locomotives and cars of to day.

MANUFACTURES.

The Taunton (Mass.) Iron Co. is adding a large three-story building to its plant.

The Georgia Manufacturing Co., Gainesville, Ga., is to add machinery to its cotton-mill.

The Central Railroad of New Jersey is erecting a machine shop, 100x75 feet, in Jersey City.

W. F. & T. P. Lippitt will erect an addition to their fertilizer works at Charlestown, W. Va.

The New York Central Iron Works, at Geneva, N. Y., has added a new boiler shop, 70x70 feet.

The recently burned tin-plate plant of Coates & Co., at Baltimore, Md., will be rebuilt immediately.

The Brooklyn City Railroad Company will erect a large three-story trolley car storehouse and repair shop.

The Hathaway Manufacturing Company, of New Bedford, Mass., is about to duplicate its cotton-mills.

The malleable iron works plant at West Troy, N. Y., will comprise eleven buildings, to cost about $100,000.

The Orion Knitting-mill, Kingston, N. C., intends to double its capital stock of $12,500, and put in more machinery.

The Paramount Knitting Co. has been established at Danville, Ill., with a capital of $24,000, by G. B. Fettig and others.

The Yale Steel Company, of New Haven, Conn., has been capitalized at $20,000. Charles Long, of Pittsburg, secretary.

The Leavitt Machine Co. will enlarge its plant, at Orange, Mass., by an addition, and will take in fifty new operatives.

Victor Harder, of New York, has purchased the Shenandoah Brass Works, Charlestown, W. Va., and will operate the same.

The foundation for a new set of rolls in the new sheet-mill of the Canonsburg (Pa.) Iron and Steel Company is being built.

Warren Bros. will erect a factory at Searsmont, Me., for the building of steam launches and the manufacture of bicycles.

The New Bedford (Mass) Gas and Electric Light Company will enlarge its plant by the erection of a 75x75-foot two story building.

The St Louis Southwestern management will soon build shops and lay out yards on the recently acquired land at Tyler, Texas.

The Fales Foundry at Troy, N. Y., which had been closed for some time, has started again in full, employing nearly 100 men.

The Honeybrook Novelty Co. has been chartered in Lancaster, Pa., with capital $50,000, for manufacturing burglar alarms, bells, etc.

The Birmingham Hardware Specialty and Machine Company is a new incorporation in Birmingham, Ala., with $18 750 capital stock.

Robert Ewing and others have incorporated the Metal Refining Co., at Nashville, Tenn., to manufacture and refine iron and other metals.

The Rodney Hunt Company are building an addition to their machine shop at Orange, Mass. The addition will be 75x40 feet, two stories high.

The George W. Wheelwright Paper Manufacturing Company is building a new boiler-house and 125 foot chimney at its plant at Hardwick, Mass.

There is prospect of a new mill to make cotton goods at Salisbary, N. C. For particulars address L. E. Steere, Asheville, N. C., who has charge.

The National Manufacturing Co. has been chartered at Knoxville, Tenn., to manufacture an engine patented by a Mr. Tubbs, of Front Royal, Va.

The Youngstown Bridge Co., of Youngstown O., has been given the contract for the building of an iron bridge over Village Creek, in Tarrant County, Tex.

A Pittsburg (Pa.) tack firm offered to remove its plant to Scottdale if a bonus of $2,500 is raised for them, and the amount has nearly all been subscribed.

The St. Louis Southwestern proposes to build a roundhouse at Tyler, Tex., on land recently purchased, and it is reported that new shops may also be built.

The Lightning Drill Co., of Chicago, has been formed, with capital stock of $100,000. A. S. Maguire, R H. Bishop and Walter Browne are the incorporators.

The Combination Wrench and Tong Co., at Pensacola, Fla., has been chartered by W. G. McClintock, W. F. Creary, and J. S. Reese, with a capital stock of $5,000.

President Hart, of the Stanley Works Co., tack manufacturers, at New Britain, Conn., whose building was burned June 2, says that the works will be rebuilt at once.

H. S. Brooker, Matthew Banyard, C. J. Hicks, C. G. Butt and A. H. Carey have incorporated the Southern Fertilizer Co., at Orlando, Fla., with a capital stock of $35,000.

The Chattanooga Car and Foundry Co. is preparing to engage extensively in the manufacture of passenger coaches, and is now increasing its capacity for that purpose.

The Halifax (N. S.) Street Railway Co. have established works where they will manufacture all their tram cars, instead of importing them from the United States as heretofore.

The National Chuck Manufacturing Company, formerly located at Mt. Vernon, N. Y., have removed their works and offices to 132d street and Park avenue, New York City.

The city of Columbia, S. C., may erect an electric light plant. W. B. Lowrance is chairman of the committee having the matter in charge, and should be addressed for information.

The Aroza Manufacturing Company has been incorporated at Chicago, Ill., to manufacture mining tools; capital stock, $25,000. Incorporators: F. F. Lincks, L. E. Knudson, and others.

The Muncie Rivet Co., at Muncie, Ind., recently incorporated, has its plant completed and equipped, and is ready for operations. It manufactures rivets and washers and light machine tools.

Extensive enlargements are being made to the shops of the Janesville Machine Company, at Janesville, Wis. The capacity of the foundry has been doubled, and several smaller buildings have been built.

The Northwestern Patent Frog and Switch Co., of Antigo, Wis., has been formed, for the manufacture of patent frogs and switches; capital stock, $100,000. D Harris, C. M Hogben and G. T. Wells are the proprietors.

The Lackawanna Hardware Company, with a capital stock of $30,000, has been incorporated at Scranton, Pa., for the manufacture and sale of hardware. The incorporators are Chas. McMullins, N. C. Cawles and John Ferber.

MacLaughlin Motor Company has been incorporated at Chicago, Ill., with a capital of $1,000,000, to manufacture, promote and operate motors and cars, and deal in patents. Incorporators: Stephen D. May, Michael Haley, Orlando Briggs.

Columbia Manufacturing Co. has been incorporated in Gowanda, N. Y., with a capital of $15,000, for stamping of metals and manufacture of plated wares. Incorporators: Joseph P. Romer, William R. Smallwood, Asher C. Stafford, all of Gowanda.

The Columbia (S. C.) Electric Street Railway, Light and Power Company has obtained a lease of 500 horse-power of water-power developed by the Columbia Canal, and will proceed to make arrangements to erect an electric light and power plant.

There is water-works agitation in Bethel, Conn.; Sandusky, Ohio; Garfield, Wash.; Wheeling, W. Va.; Martinsville, Va.; McComb, Ill.; Madrid, Iowa; Bayard, W. Va.; Orono, Me; Buckley, Wash.; Edmund, Okla; Spadra, Ark.; Baird, Texas; Kendrick, Idaho.

The Jackson Bridge and Iron Co., of Jackson, Mich., has been formed, for the manufacture of bridges. The following persons are stockholders: John H. Sairs, Herman Maasberg, Fred J. Sairs, Henry Leiseberg, Charles E. Pawling, August Helm, all of Jackson, Mich.

The Hancock Switch and Frog Co., of Manchester, N. H., has been formed for the manufacture of railroad appliances, etc. The following are the interested persons: A. J. Hodden, Samuel G. Lane, J. Whitney Beals, Jr., F. C. Twombly and James C. Lovejoy, of Manchester, N. H.

The plans of the Great Northern for the machine and car repair shops, stations, roundhouse, etc., to be built at Spokane, Wash. have been completed. The machine shop will have a capacity of 75 engines a year, and will employ about 250 men. The buildings are to be finished by the beginning of the new year.

The Littell Indicator Lock and Car Seal Co., of Denver, Col., is a recently incorporated concern with capital stock of $100,000. which proposes to manufacture the Littell indicator lock and car seal. The directors of the company are: Ira A. Littell, of Colorado Springs, and R. W. English and Thornton Woodbury, of Denver, Col.

The Ohio Machine Tool Company, Cincinnati, O., have increased their line of manufacture, and are now making pulley lathes for the simultaneous boring and turning of pulleys, blank gears etc. These machines will cut down both sides of a gear at one operation, while the diameter is being turned, and bore at the same time.

It is stated that the Sweet Straight-line Engine Company, of Syracuse, N. Y., finding the demand for the Sweet straight-line engine greater than their present facilities for manufacturing it, are looking about with a view to establishing branch works at some other point. In this connection Hartford, Conn., has been favorably mentioned.

The Western Foundry Company, Chicago, Ill., organized for the manufacture of light iron castings, will erect at once frame buildings 70 x150' and 40 x 100'. It will need a boiler 5 x16', an engine of 50 horse-power, 1,000' of belting, lathes, pulleys, drills, shafting, cupola, fan and tumbling barrels. The company expects to fill orders by July 15th. D. F. O'Neil is president.

Ground was broken at Meridian, Miss., on the 16th inst., for the new railroad shops of the Queen & Crescent Railroad, to replace those destroyed by fire some months since. The structure will be of brick, 500 feet long, and will cost $50,000. It will be one-third larger, and with greatly increased capacity over the old. The contract calls for completion before October 1 next.

It is reported that a company composed of Bellaire, Wheeling and Pittsburgh capitalists have purchased the plant of the Ætna Glass and Mfg. Company, at Bellaire, Ohio, which they will remodel for the manufacture of stamped ware. It is proposed to turn out tin and granite ware and tubular lanterns. The capital stock of the new concern is reported to be $150,000, with privilege of increasing to $250,000.

The Scranton Axle Works have been organized at Scranton, Pa., with a capital stock of $150,000 The officers of the company are: J. M. Kemmerer, president; Thomas J. Moore, secretary, and E H. Ripple, treasurer. A building is now in course of erection, and with the machinery, which is nearly all purchased, will cost about $60,000. The company hope by November next to turn out from 300 to 400 sets of axles daily. They are the owners of eleven new patents relating to the manufacture of axles.

We recently noted the fact that the Rudolphi & Krummel Machine Works had been established at Chicago. Since then we have received the following: "We take pleasure in informing you that we have established ourselves as the Rudolphi & Krummel Machine Works. Having both been in responsible positions in the drawing room and shop for a long term of years with the largest eastern firm manufacturing presses, sheet metal-working machinery, etc., we feel induced to follow this same line of business. In recognition of the growing demand for special and automatic machinery in many lines of manufacture, and encouraged by our previous success in this particular class of machinery, we will make this a specialty, and shall build either after our own designs or those furnished. We are now making designs for a full line of open-back power presses, and two sizes of upright milling machines, and will place both on the market at the earliest possible date. These machines will embody new and advantageous features, which will recommend them strongly to intending purchasers. Our shop, located in close proximity to the business center of Chicago, is fitted up entirely with the best modern tools. RUDOLPHI & KRUMMEL MACHINE WORKS."

Machinists' Supplies and Iron.

NEW YORK, July 23 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14 50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market remains unchanged.

We quote Hallett's, 10¾c. to 11c; Cookson's, 14c. to 14½c.; and L. X., 12½c. to 12⅝c.

Lake Copper—The market is firmer, and prices higher. There are large buyers at 11.35c. to 11.40c., and in some cases could not be bought under 11½c. Lake Copper is held at 10¾c. to 11¼c.

Lead—The market is unsettled, and in the buyer's favor. Round lots are offered at 4⅛c., and carload lots at 4.15c. to 4.20c.

Lard Oil—The market is quoted at 61c. for Prime City. Western on spot is quoted at 60c.

Spelter—Sales have been reported at 4 75c. to 4 80c. Prices are irregular, and seem to favor buyers.

Tin—The market is unsettled. Spot prices, 20.80c. bid, and 20.90c. asked.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Pattern Makers, Birmingham Iron Foundry, Birmingham, Conn.

Wanted—Sit. as draftsman; exp'd on Corliss eng., indicating; good refs. Box 34, AM. MACHINIST.

Man (26 y'rs) 4 y'rs in shops, 3 y'rs drawing and designing, wants good job. Box 35, AM. MACH.

Wanted—Sit. by exp mach. shop foreman on eng. & gen. mach'y; understand ind'r. J. A., AM. MACH.

Wanted—Position as foreman boiler maker; reference furnished. Foreman, AMERICAN MACHINIST.

Wanted—Situation as a first-class tool maker. Address "C.," Quarryville, Conn.

Wanted—A competent molder with small capital to take one-third interest in foundry and machine shop. E. Diehm, Massillon, Ohio.

Tool maker wishes engagement; best of references, long exp., and capable of taking charge of tool room. Box 36, AMERICAN MACHINIST.

Wanted—Sit. by a prac. mach. & draftsman; 5 y'rs exp. as foreman on marine and stationary eng., mill machinery and jobing. "P.," AM MACHINIST

Wanted—Draftsman exp'd in Corliss and high-speed engines. Give age, experience, references, and salary wanted. "Star," AMERICAN MACHINIST.

Wanted—Machinist, with $5.00, to take charge of an established manufacturing company. P. O. Box 406, Baltimore, Md.

Wanted—Pos. by mech. draftsman, German, with theoretical education and shop practice; exp in power transmission & gen. mach'y. P. L., Am. MACH.

Wanted—Position by draftsman who is familiar with Corliss engine work. Address Box 33, AMERICAN MACHINIST.

Wanted—First-class die makers. Competent on round combination dies for tinware. Niagara Stamping and Tool Co., Buffalo, N. Y.

Wanted—Situation as superintendent or foreman of foundry; 15 years' experience on marine and heavy castings of every description; best of references given. Address Box 25, AM. MACHINIST.

Wanted—Immediately, 1st-class planer hands on machine tool work; also 1st-class scraper, and an all around machinist. Address The Henley Machine Tool Works, Richmond, Ind.

Wanted—First-class man, who has had long experience in Corliss engine building; must be first-class draftsman and inspector, and able to figure on compound condensing plants. Address, giving exp., ref., and salary desired, Box 28, AM. MACH.

Traveling salesman wanted to represent a firm building high-speed automatic engines; a mechanical engineer preferred; one familiar with steam engineering. Address, stating previous experience and salary expected, Business, care AM. MACH.

A mech. eng. desires a position of responsibility in a manuf'y; exper'd in every detail in mod meth. on interchangeable work, devis'g labor-saving tools and adapting mach'y to produce econom'l results; excellent designer & draftsman. Box 32, AM. MACH.

Wanted—Two young men of some education and exp as draftsmen in a heating and ventilating department; position offers plenty of opportunity for advancement; must be quick and accurate at figures. Address, stating age, experience, with ref., & salary wanted, Buffalo Forge Co., Buffalo, N. Y.

Wanted—At Sibley College, Cornell University, Ithaca, N. Y., several good workmen as instructors in the various shops; should be about 30, studious, skillful, interested in their work, and appreciative of the opportunities offered in residence at a great university; pay moderate, but positions otherwise attractive to the right men. Address the Director.

Foreman wanted in small shop employing 8 or 10 men; must have good executive ability and systematic methods for cost accounts, and fertility in expedients for accomplishing proper results without special tools. Jobbing and repairs to hand-pumping and hoisting mach'y, brass finishing, etc. State experience, refs,, etc., Watson, AM. MACHINIST.

Wanted—Superintendent for one of the largest, most progressive and best known machine tool concerns in the United States; will have entire charge of works; none need apply except those now in similar position with one of the standard tool builders of the country; must be progressive, and in touch with the most modern shop practice. For the right man this is the opportunity of his life; much more back of it than can appear in an advertisement; all communications strictly confidential. Box 31, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wall Drills complete, $25. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Sliding Gauges, etc. E. G. Smith, Columbia, Pa.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

PURE FEED-WATER For Steam Boilers.

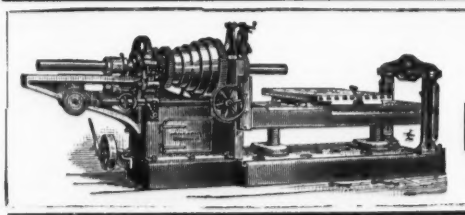
THE BUNNELL FILTER AND PROCESS Furnishes Steam Boilers with water that is absolutely freed from all scale producing substances. Guaranteed or no sale.
BRADLEY & COMPANY, SYRACUSE, N. Y.

VANDERBEEK'S TRADE MARK.
MILLING MACHINE.
FIVE STYLES
THE STATES MACHINE CO., HARTFORD, CONN.

DYNAMOMETERS AND THE MEASUREMENT OF POWER.
BY PROF. J. J. FLATHER.
215 Pages, Illustrated, 12mo, Cloth, $2.00.
JOHN WILEY & SONS, New York.

STEEL TUBES
WELDLESS
SMOOTH - COLD DRAWN
John S. Leng's Son & Co. New York.

Machine Shop For Sale.
$3000. Machinery almost new, rent low, power furnished; well equipped for general work; manufacture tools, special and experimental work. Bargain. Call or address, MACHINIST, 36 Penn St., Brooklyn, N. Y.



BETTS MACHINE CO., WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Stolpe's Universal Punch is new and the best: write for circular. Stolpe, 154 W. 27th St., N. Y.

Design & superintendence of mach'y. Drawings, etc., made. Claud Mantle, 598 E. 134th St., N. Y.

George D. Slade, dealer in molding sand of all grades, Waterford, N. Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

For Sale, Cheap—Patent of grip pipe wrench. Address B. F. Chappell, Quarryville, Conn.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—To sell the entire right of my universal bench vise; best testimonials from pattern makers and others. J. F. Emmert, Box 313, Waynesboro, Pa.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 203 Broadway, New York.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Wanted—To manufacture something in the machinery line, anything to make a business; good thing to the right party to have their work made cheap. Address Jno. E. Collins, 20 Mill street, Watertown, N. J.

LOOK AT THESE BARGAINS IN

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 28 in. x 15 ft. Blaisdel, Plain Rest, Raised to 36 in.	Good order.
1 28 in. x 12 ft. " Compound Rest, Raised to 40 in.	A1 condition.
1 26 in. x 8 ft. Blaisdel Compound Rest Raised to 36 in.	Good order.
1 16 in. x 6 ft. Hatfield, Rise & Fall Rest.	
1 15 in. x 6 ft. Blaisdel, " " " with Chuck.	A1 condition.

PLANERS.

1 22 in. x 22 in. x 5 ft. N. Y. S. E. Co.	A1 condition.
1 22 in. x 22 in. x 5 ft. Whitcomb.	Good as new.

MISCELLANEOUS.

1 Barnes Sensitive Drill Press.	Good as new.
1 Pratt & Whitney 6 Spindle Drill Press.	A1 condition.
1 Garvin No. 4-4 Spindle Drill Press.	" "
1 12 in. Gould & E. Crank Shaper.	Good as new.
1 No. 3 Cincinnati Universal Miller, complete with Rack Cutting and Vertical Attachments and lot tools.	
1 Ames Two Spindle Profiler, with Cutters.	Good order.
1 No. 3 Pratt & Whitney Plain Screw Machine.	" "
1 No. 2 " " Screw Machine, Automatic Chuck and Wire Feed.	Good as new.
1 16 in. x 8 ft. Square Arbor Fox Lathe, with Chasing Box and set of Overtail Stock.	A1 condition.
1 15 in. x 5 ft. Jones & Lamson Turret Lathe.	" "

Write for list of over 400 New and second-hand Machines in stock.

THE GARVIN MACHINE COMPANY,
LAIGHT AND CANAL STS., NEW YORK.

Second Hand and New Machinery

ON HAND.

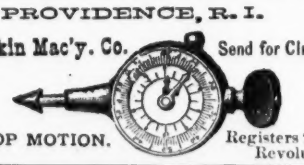
10 ft. x 10 ft. x 16 ft. Planer.	1 Head.			
72 ft. x 48 ft. x 21 ft. do	3 Heads, Detrick & Harvey, new.			
62 in. x 48 in. x 17 ft. do	1 do			
54 in. x 42 in. x 24½ ft. do	2 do			
46 in. x 33 in. x 30 ft. do	2 do			
39 in. x 36 in. x 12 ft. do	1 do			
30 in. x 30 in. x 7 & 8 ft. do	1 do			
26 in. x 26 in. x 6 ft. do	1 do			
25 in. x 24 in. x 6 ft. do	1 do			
22 in. x 21 in. x 5 ft. do	1 do			
96 in. Raising Blocks to 13 ft. x 26 ft. Bed Engine Lathe.				
50 in. x 30 ft. Bed Triple Geared.	New	do	do	
48 in. x 22 ft. do	do	do	do	
42 in. x 17 ft. do	A1	do	do	
32 in. x 12, 14, 16, 18 ft. Bed.	New	do	do	
28 in. x 12, 14, 16, 18 ft. do	do	do	do	
21 in. x 10, 12 ft. do	do	do	do	
20 in. x 7½ & 8 ft. do	2d Hand	do	do	
18 in. x 6, 7 & 8 ft. do	New &	do	do	
17 in. x 8 ft. do	do	do	do	
16 in. x 6 & 8 ft. do	do	do	do	
15 in. x 6 & 8 ft. do	do	do	do	
14 in. x 6 ft. do	do	do	do	

Car Axle Lathe, Bement.
9 & 12 in. Stroke Slotters.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22, 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
2 Garvin No. 4 Millers, A1.
1 Brainerd No. 3 Miller, A1.

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK.

THE STANDARD REVOLUTIONS COUNTER.
PROVIDENCE, R. I.

A. B. Pitkin Mac'y. Co. Send for Circular.



PAT. STOP MOTION. Registers 2,000 Revolutions.

PATENTS

TRADE-MARKS, CAVEATS, COPYRIGHTS.

Send model or sketch for free advice as to patentability. Full information in my fifty page book, FREE. Address

SAML. C. FITZGERALD, Atty.,
1003 F Street, - - WASHINGTON, D. C.

Machine Tools in Stock.

ENGINE LATHES.

78 in. swing, 9 ft. between centers				Sellers
38 do	17 ft. bed.	New		Fifield
30 do	14 do	do		do
27 do	16 do	do		
24 do	12 do	do		Fifield
24 do	12 do	do		Fitchburg
24 do	12 do	do		Flather
22 do	10 do	New Pattern		Fifield
22 do	12 do	do		do
22 do	12 do	New		Blaisdell
22 do	8 do	do		Flather
22 do	10 do	do		do
20 do	8 do	do		do
20 do	10 do	do		do
18 do	8 do	do		do
18 do	10 do	do		do
18 do	8 do	do		Blaisdell
18 do	16 do	do		do
16 do	6 do	do		Flather
16 do	6 do	do		Blaisdell
15 do	6 do	do		Flather
14 do	6 do	do		do
14 do	6 do	do		Blaisdell
12 do	6 do	do		do

PLANERS.

42 in. wide, 42 in. high, 12 ft. long, 2 heads				Gleason
36 do	36 do	8	do	Pease
30 do	30 do	8	do	do
30 do	30 do	8	do	Whitcomb
30 do	30 do	8	do	Flather
26 do	26 do	6	do	do
24 do	24 do	6	do	do
24 do	24 do	6	do	Whitcomb
22 do	22 do	5	do	do
22 do	22 do	6	do	Flather

SHAPERS.

12, 16, 20 and 24 inch stroke	Eberhardt
15 and 24 inch stroke	Hendey

UPRIGHT DRILLS.

20, 21, 25, 28, 30 and 36 inch swing	Prentice
20, 23, 25, 28 and 34 inch swing	Blaisdell
60 inch swing Radial Drill	Baush

HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.
CHICAGO BRANCH, 12 and 14 South Canal Street.

MACHINISTS'

BOILER AND BRIDGE TOOLS.

NEW AND SECOND HAND.

Engine Lathe,	13 in. x 6 ft.,	Hollow Spindle	Ames Mfg. Co.
" "	14 in. x 6 ft.,	Taper Attachment.	Hendey
" "	14 in. x 6 ft.,	Compound Rest.	Fitchburg
" "	14 in. x 6 ft.,	Hollow Spindle.	Ashton Hand.
" "	16 in. x 6-8-10 ft.,	Extra Heavy.	A1 order. Hendey
" "	16 in. x 6-8 ft.,	New, Heavy Pattern.	Fitchburg.
" "	16 in. x 6 ft.,	with Gdg. Att., Pond.	Good order.
" "	16 in. x 6 ft.,	Lathe and Morse.	" "
" "	16 in. x 6-8 ft.,	Special Low Price.	Standard.
" "	18 in. x 6 8-10 ft.,	C'p'd Rest, and Taper.	Hendey.
" "	18 in. x 8-10 ft.,	New Heavy Pattern	Fitchburg
" "	18 in. x 8 ft.,	Fair Order. Low Price.	New Haven.
" "	20 in. x 8 ft.,	Hollow Spin. Cross Feed,	Perkins. Good order.
" "	20 in. x 8-10-12-14 ft.,	Spec. Low Prices,	Standard.
" "	22 in. x 10 ft.,	C'p'd Rest.	Perkins
" "	22 in. x 13 ft.,	Old Style, Low Price,	Fair order.
" "	24 in. x 10 ft.,	" " "	" "
" "	24 in. x 12 ft.,	C'p'd Rest, Putnam.	Good order
" "	24 in. x 12 ft.,	" "	Perkins.
" "	24 in. x 12 14-16 ft.,	Special Low Price.	Standard.
" "	28 in. x 16 ft.,	Extra Heavy.	"
" "	32 in. x 12 ft.,	Special Low Price.	"
" "	36 in. x 14 ft.,	New Heavy Pattern.	Fitchburg.
" "	40 in. x 20 ft.,	Heavy Triple G'd.	Good order.
" "	60 in. x 20 ft.,	Old Style. Fair.	Very Low Price.
" "	66 in. x 24 ft.,	for Facing and Boring,	" "

Planers, 24x6 8 ft. 36x8 ft., 48x10 ft., 72x12 ft.
Shapers, 6-9-15-24 and 30 in. stroke.
Upright Drills, 20-24-28-32 and 34 in. swing.
Radial " 3 4-5 and 6 ft. Arms.
Gang " 3 and 4 Spindles.
Screw Machines, 15-16, 1 3-8 and 2 1-8 in. holes.
Milling Machine, Hand, Power and Universal.
Slotting Machine, 9 in. stroke, Modern Style.
Pipe Machine, 4 in., with Dies. Morris & Tasker.
Bolt Cutter, 1¼ in. Sellers, Low Price.
Bradley Hammer, 60 lb Good order.
Boiler Rolls, 6 ft., Modern, heavy and powerful.
" " 8 10 ft., New Improved Patterns.
Riveting Machine, 60 in., with complete hoisting rig.

J. J. McCABE,
SUCCESSOR TO
E. P. BULLARD'S
N.Y. Mach'y Warerooms
68 Cortlandt Street,
NEW YORK.

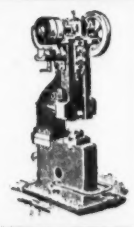
HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.

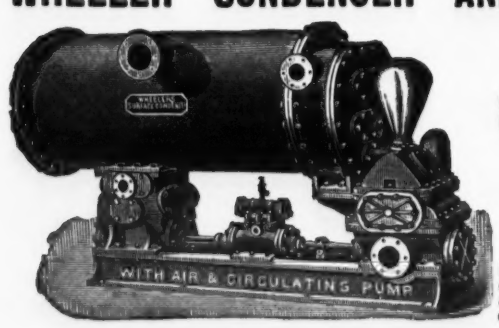
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.

WRITE FOR CATALOGUE TO

THE HACKNEY HAMMER CO.,
20 Johnson St., CLEVELAND, O.



WHEELER CONDENSER AND ENGINEERING CO.



92 & 94 Liberty Street, New York.

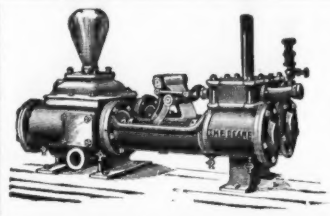
MANUFACTURERS OF IMPROVED

SURFACE CONDENSERS.

ALSO SUCCESSORS TO THE

Colwell Iron Works.

Machinery for Sugar Plantations and Refineries. Vacuum Pans, Double and Triple Effects, &c. Blowing Engines for Blast Furnaces. Iron and Brass Castings for the Trade. Heavy Machinery a Specialty.



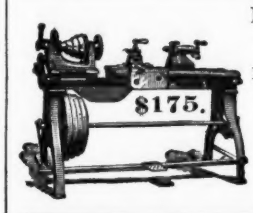
THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
PITTSBURGH. CHICAGO. NEW YORK.

HAVE YOU TRIED

Reducing the cost of getting out work by using better **STEEL** for your Tools?

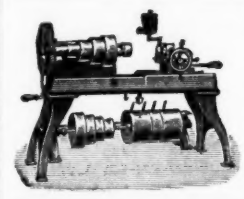
We can be of service to you in this direction.



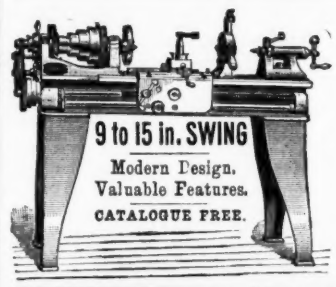
Improved Screw Cutting Foot and Power **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.



BOLT-CUTTING, NUT-TAPPING AND PIPE-THREADING MACHINES,
—ALSO—
DRILLING MACHINES, for Hand and Power Use.
MANUFACTURED BY
WILEY & RUSSELL MFG. CO., Greenfield, Mass.
SEND FOR NEW CATALOGUE.



SEBASTIAN LATHE CO.

43 & 45 Central Ave., Cincinnati, O.

Manufacturers of Foot and Power

ENGINE AND SPEED LATHES,

For General Machine and Jobbing Shop, Electrical and Experimental Work.

DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

R. MUSHET'S SPECIAL AND TITANIC. STEELS.

How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known steel. This will make the first cost of "Mushet's" look insignificant.

B. M. JONES & CO.,
Sole Representatives in the United States.
11 & 13 Oliver St., BOSTON, MASS.
113 Liberty St., NEW YORK.

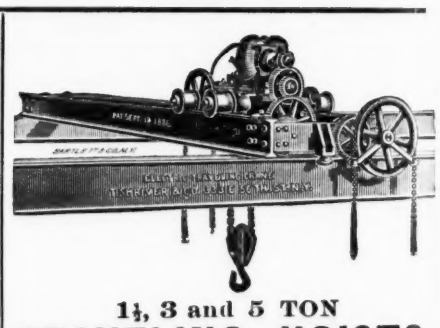
BRASS-WORKING TOOLS.

SPECIAL MACHINERY.

BARDONS & OLIVER Cleveland, Ohio.

PRICES on APPLICATION

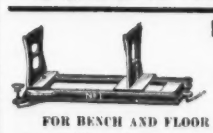
SCREW MACHINES.



1½, 3 and 5 TON TRAVELING HOISTS,

Operated by hand or by Electric Motor.

T. SHRIVER & CO., 333 East 56th St., N. Y.



Bowsher's BALANCING **WAY**

FOR BENCH AND FLOOR USE. 3 SIZES AND STYLES.

A new idea. A time saver. A tool to take the place of the devices in present use for balancing pulleys armatures, cutter heads and rotary parts of machinery in general. Ways are *chilled* and *ground*. Spirit levels attached. Substantial, accurate, clean. Send for circular.

N. P. BOWSHER, South Bend, Ind.

MACHINERY For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information address the Manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

TO LET.

The Engine Works at Newburgh, N. Y., at present occupied by Wm. Wright, is offered to let from May 1st, 1892.

The Property consists of

MACHINE SHOP, FOUNDRY, BOILER, FORGE AND PATTERN SHOPS, with a full equipment of tools.

The works are located in the heart of the city, and convenient to railroad and river transportation.

For terms, apply to

HOMER RAMSDELL,
NEWBURGH, N. Y.

BORING & TURNING MILLS

BRIDGEPORT MACHINE TOOL WORKS

E. P. BULLARD. PROPR.
BRIDGEPORT ~ CONN ~

NICHOLSON FILE COMPANY,
PROVIDENCE, R. I.

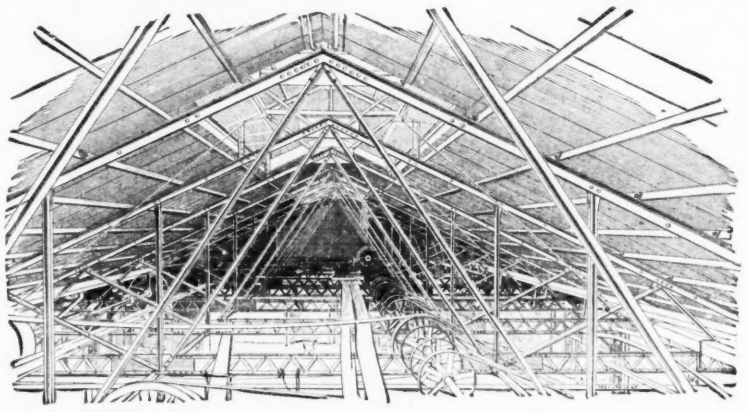
FILES AND RASPS
FOR EVERY VARIETY OF WORK.

THE BERLIN IRON BRIDGE CO.

Office and Works:

No. 8 Railroad Ave., East Berlin, Conn.

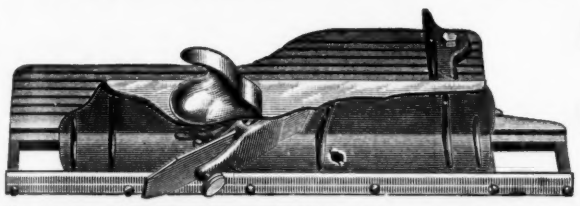
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.



The above illustration is taken direct from a photograph of an Iron Forge Shop designed and built by us for the Franklin Moore Co., at Winsted, Conn. The view is taken in the roof of the building, in order to show the construction. The building is 40 feet in width by 100 feet in length, made entirely of iron, without any woodwork whatever about it. This construction is absolutely fire-proof for Forge Shops, Rolling Mills, and that class of buildings where fire is liable to occur from sparks.

SEND FOR OUR ILLUSTRATED CATALOGUE.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.

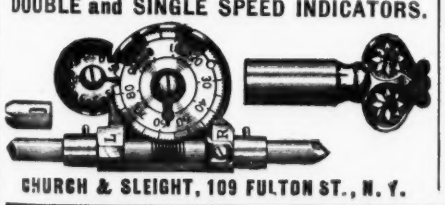


A. J. WILKINSON & CO.
Box 3600.
BOSTON, MASS.

SEND FOR CIRCULAR.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

CHURCH'S
DOUBLE and SINGLE SPEED INDICATORS.



CHURCH & SLEIGHT, 109 FULTON ST., N. Y.

World's Fair Exhibitors
ATTENTION.

Do you desire the services of a reliable company to receive, install and superintend your exhibit during the **World's Columbian Exposition?** We can save you money. Unexceptional references. Write for pamphlet and particulars.
CHICAGO COMMERCIAL COMPANY,
501, 502, 503 Home Insurance Bldg., Chicago.

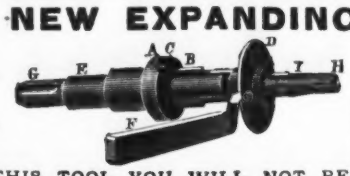
BRASS AND BRONZE CASTINGS
A SPECIALTY.

By a molder of 50 years experience. Castings guaranteed true to pattern. Get my prices.
GEORGE HIBSCH, 4 1-2 Plain St., Albany, N. Y.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.

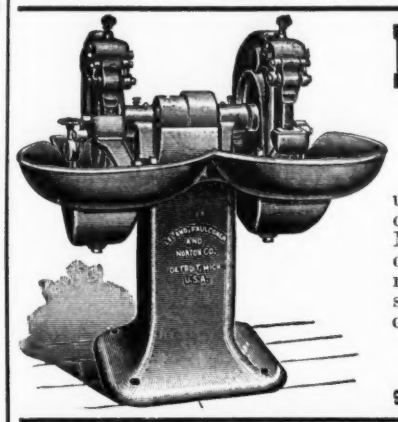
Taking anything from ⅛ to 1 inch inclusive.
Price $5.00
Patented Dec. 25, 1877.



Machinist's Size.

No.			PRICE.
1	⅛ to 1	in.	$10
2	1	" 1½ "	14
3	1½	" 2 "	18
4 (with screws)	2	" 3 "	32
5 " "	3	" 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd. 21 Cross St., London, England.



LELAND, FAULCONER & NORTON CO.

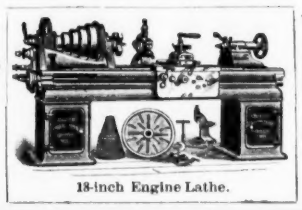
WET EMERY GRINDER.

Any amount of water easily applied without the use of Pump, Hose, Treadles, Cocks, or any of the objectionable features common in this class of Machine. Truing Device, which is inexpensive, does the work perfectly and quickly. The whole rig practically as simple as the old-fashioned grindstone trough and much more effective. Send for circular.

LELAND, FAULCONER & NORTON CO.,
96 TO 106 BATES STREET, DETROIT, MICH.

FITCHBURG MACHINE WORKS,

MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
SEND FOR CATALOGUE E.



18-inch Engine Lathe.

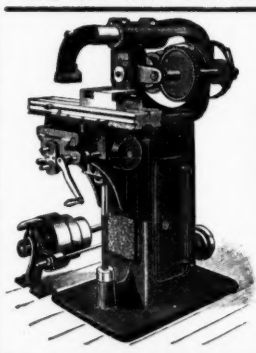
THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
FITCHBURG, MASS.

THE TOWNSEND FOUNDRY AND MACHINE SHOP

Machinery and Machinery Castings
OF ALL KINDS.
PATTERN MAKING
And Job Work Desired.

RUFUS K. TOWNSEND, Prop.
ALBANY, N. Y.
Send for Gear Catalogue.

WE ARE FULLY EQUIPPED TO BUILD LIGHT AND HEAVY SPECIAL MACHINERY, AND WOULD BE PLEASED TO FURNISH ESTIMATES.



PLAIN and UNIVERSAL MILLING MACHINES

of approved design and high grade workmanship.

KEMPSMITH
MACHINE TOOL CO.,
Milwaukee, Wis.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.

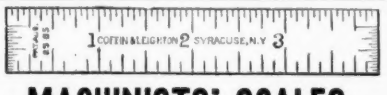
Experimental Work of every Description,

Mechanical and Electrical. Contractors for the manufacture of specialties, or can furnish complete plants for their manufacture. Make Dies, Special Tools, Gauges, Drawings, Patterns, Models. Inventions perfected. Estimates furnished. Correspondence solicited.

Send for Circular of SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

TOOLS FOR QUICK DELIVERY.

Radial Drills 52 in. and 80 in. Engine Lathes 16 in. by 6 ft., 18 in. by 6 ft. 20 in. by 8 ft. 21 in. by 10 ft. and 12 ft. Pulley Lathes 26 in. 36 in. 60 in. Ohio Machine Tool Wks., Cin., O.
WM. LODGE, President.



MACHINISTS' SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

LARKIN'S BRASS AND IRON FOUNDER.

A new and thoroughly revised edition.—**Just Ready.**

THE PRACTICAL
BRASS AND IRON FOUNDER'S GUIDE

A Treatise on Brass Founding, Moulding, the Metals and their Alloys, etc. By JAMES LARKIN, late Conductor of the Brass Foundry Department in the Fenn Works, Philadelphia. A new revised and greatly enlarged edition. In one volume, 12mo, 400 pages.

Price $2.50 by mail, free of postage to any address in the world.

CONTENTS.—Among the most important and entirely new sections of this edition of this valuable and popular book are the following: Behavior of Metals and Alloys in Melting and Congealing; Malleable Iron Castings; Wrought Iron or Mitis Castings; Manufacture of Steel Castings; Casting of Brass; Casting of Bronze; Bell Founding; Chill Casting; Casting without Core; Casting on to other Metals; Casting Iron and other Metals upon Lace, Embroideries, Fern Leaves and other Combustible Materials; Some Modern Bronzes.

☞ *Descriptive circular, giving full table of contents of the above book, sent free to any one who will send his address.*

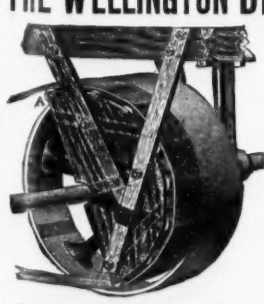
☞ *Our new revised Descriptive Catalogue of Practical and Scientific Books, 88 pages, 8vo, and our Catalogue of Books on Steam and the Steam Engine, Mechanics, Machinery, and Dynamical Engineering, List of Books on Electro-Metallurgy, Moulding, Founding, Pattern Making, Metal Working, etc., and other Catalogues, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.*

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS & IMPORTERS
810 Walnut St., Philadelphia, Pa., U. S. A.

BUFFALO FORGES.

BUFFALO FORGE CO., BUFFALO, N. Y.

THE WELLINGTON BELT HOLDER.



Cut shows Holder in position beside driving pulley.

Large or small belts shifted from driving pulley and held at rest, and easily slipped back when machine is to be started.

It dispenses with loose pulleys, saves belts, and is perfectly safe.

It is *cheap.*

Write for descriptive circular and price list to

COOKE & CO.,
163 & 165 WASHINGTON STREET, NEW YORK,
And mention American Machinist.

BOSTON GEAR WORKS,
35 Hartford St., Boston, Mass.
HEADQUARTERS for GEARS.

Send for 1892 Catalogue. 80 Illustrations. Free.

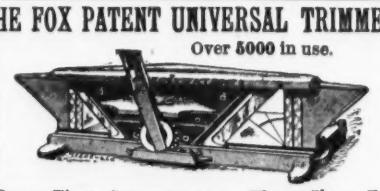
F. J. SCHMITT & CO.,
30 & 32 Franklin Street,
NEWARK, N. J.

VAUGHN'S PAT. POWER HAMMER
BUILT ON THOROUGHLY Mechanical Principles only.
Can be handled with ease.

SEND FOR CIRCULAR

THE FOX PATENT UNIVERSAL TRIMMER.
Over 5000 in use.

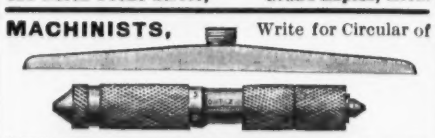
ORIGINAL



IMPROVED

Saves Time, Saves money. Three Sizes, Four Styles, from New Patterns. *No Pattern Room Complete without Them.* Send for Catalogue.
Beware of Imitations. we will prosecute all Infringements.
THE FOX MACHINE CO.,
325 North Front Street, Grand Rapids, Mich.

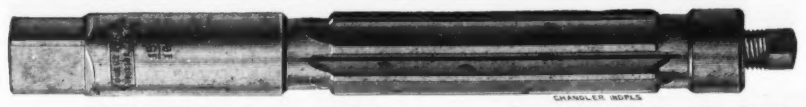
MACHINISTS, Write for Circular of



COMBINATION INSIDE MICROMETER CALIPER AND DEPTH GAUGE.
Price, $2.50. J. T. SLOCOMB & CO., Prov., R. I.

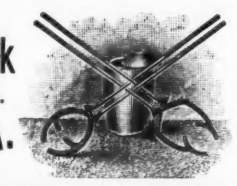
WORTHINGTON
PUMPING ENGINE
FOR
WATER WORKS.
SIMPLE, COMPOUND, OR TRIPLE EXPANSION, HORIZONTAL OR VERTICAL
HIGHEST DUTY GUARANTEED.
COMPLETE DESCRIPTIVE PAMPHLETS ON APPLICATION.

HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO, ST. LOUIS, ST. PAUL.



Established in 1874.
CLEVELAND TWIST DRILL CO.
Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.

"HOWE'S SPECIAL" TOOL STEEL.
FOR THE Finest Work
ESTABLISHED 1859.
HOWE, BROWN & CO., L'T'D, PITTSBURGH, PA.
93 John St., New York. 127 Oliver St., Boston. 228 Lake St., Chicago.



GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

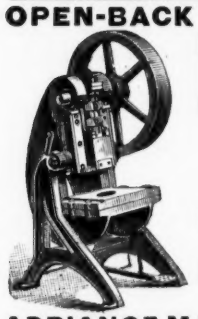
Pawling & Harnischfeger
Milwaukee, Wis.
Horizontal Drill and Boring Tools.
Column Facing Lathes.
Pit Lathes.
Truck Wheel Grinders.
Boring Bars, &c.
Electric, Steam and Hand Cranes.

AMERICAN AND FOREIGN PATENTS.
We refer to well-known men and establishments in the machine trades for whom we have done business.
Epitome of the World's Patent Laws and Statistics Sent Free on Application.
(Registered English Patent Agent, according to Act of Parliament.)
F. W. BARKER'S PATENT AGENCY,
THE BENNETT BUILDING, 93-99 NASSAU ST., N.Y.
Monument Chambers, King William St., London, E. C., England.

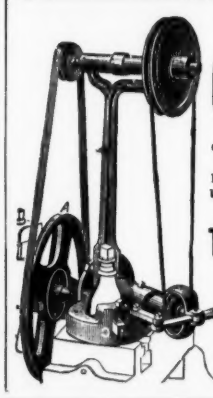
THE PECK PATENT DROP PRESS
MINER & PECK M'F'G CO.
SUCCESSORS TO BEECHER & PECK
NEW HAVEN, CONN.
DROP FORGINGS

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

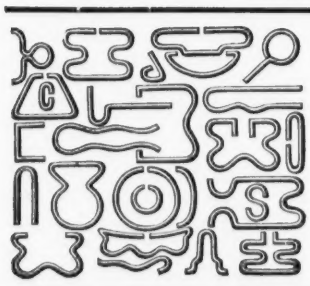
OPEN-BACK ADJUSTABLE



Power Press
Vertical
—OR—
Inclined.
For Cutting and Forming
SMALL ARTICLES OF
Sheet Metal, Leather, Paper, Etc.
ADRIANCE MACHINE WORKS,
MFRS. SHEET METAL MACHINERY,
Plymouth & Jay Sts., - BROOKLYN, N. Y.



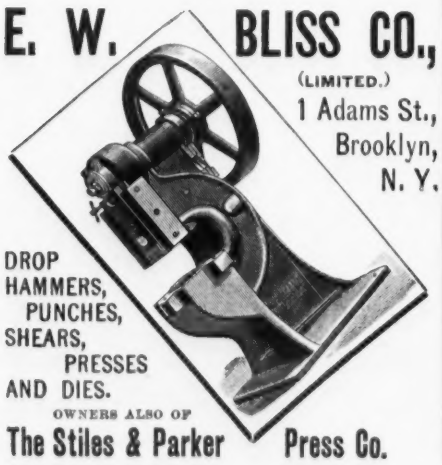
LATHE
Center Grinder
For truing Hardened centers in place.
A cheap and effective tool, needed in every well-regulated machine shop.
Write for prices to
Trump Bros. Mach. Co.
Wilmington, Del.
FOR SALE BY
Chas. Churchill & Co. Ltd.,
21 Cross St., Finsbury, London, England.



BLAKE & JOHNSON,
WATERBURY, CONN.
BUILDERS OF
WIRE FORMING MACHINES
WITH F. B. MANVILLE'S PATENT SLIDING FORMER.
For making articles from the coil, of either round, half round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.

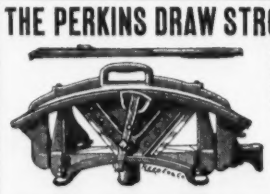
The Henderson Machine Tool Co.
Office and Works, 23d and Filbert Sts., PHILADELPHIA, PA.
MANUFACTURERS OF
SHEET METAL PRESSES, SHEARS, TOOLS, ETC.
MACHINISTS' SHAPERS, MILLING MACHINES
AND SPECIAL MACHINES.
Correspondence solicited.

E. W. BLISS CO.,
(LIMITED.)
1 Adams St., Brooklyn, N. Y.



DROP HAMMERS, PUNCHES, SHEARS, PRESSES AND DIES.
OWNERS ALSO OF
The Stiles & Parker Press Co.

THE PERKINS DRAW STROKE TRIMMER,

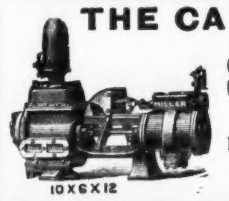


An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.
PERKINS & CO.,
Grand Rapids, Mich.
STOCKS, NEAVE & CO.,
Manchester, England.

Paragon Drawing Instruments, Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Slide Rules, Standard Profile and Cross-section Papers. Catalogue to professional people on application.

THE BUFFALO STEAM PUMP CO.,
MANUFACTURERS OF BUFFALO, N. Y.
STEAM PUMPS
FOR ALL SERVICES.
NEW YORK OFFICE, 76 JOHN STREET.

THE CANTON STEAM PUMP CO., CANTON, OHIO.
MANUFACTURERS OF
STEAM PUMPS for EVERY PURPOSE.
BOILER FEEDERS A SPECIALTY.
NEW DESIGNS AND IMPROVEMENTS.
ABSOLUTELY FIRST CLASS.
Discounts and Terms on Application.

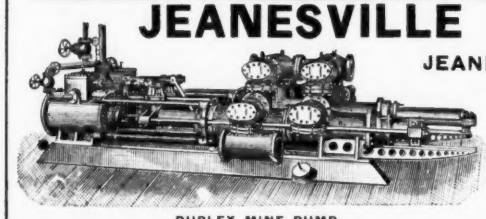


10X6X12

2¼X1¼X2½

SNOW STEAM PUMP WORKS,
BUFFALO, N. Y.
STEAM PUMPS, POWER PUMPS, &c., FOR ALL SERVICES.

JEANESVILLE IRON WORKS,
JEANESVILLE, LUZERNE CO., PA.
BUILDERS OF
SPECIAL PUMPS OF ALL KINDS.
DUPLEX OR SINGLE, SIMPLE OR COMPOUND.
MINE PUMPS, SINKING PUMPS, PRESSURE PUMPS, VACUUM PUMPS, ARTESIAN WELL PUMPS, POWER PUMPS, ETC., ETC.

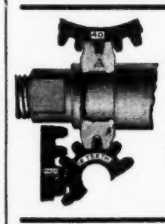


DUPLEX MINE PUMP.

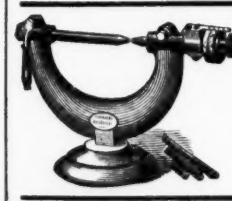
"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
203 BROADWAY,
NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30, or single copies, 5 cts. each, postpaid.

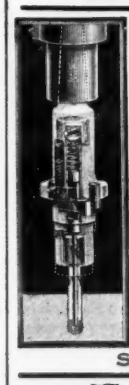


CLOUGH'S
Combination Gear Cutters.
One pair cuts a pitch from 12 to a rack, inclusive. Of variable shape and interchangeable. These cutters are kept in stock and orders filled promptly. Special cutters and sizes made to order promptly. For descriptive circular, prices and discounts, address
R. M. CLOUGH,
TOLLAND, CONN.



SWEET'S
Measuring Machine.
The only micrometer that will not lose its accuracy by wear.
Satisfaction Guaranteed.
SYRACUSE TWIST DRILL CO.,
Syracuse, N. Y.

SOFT GRAY IRON CASTINGS.
From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
CANANDAIGUA, N. Y.

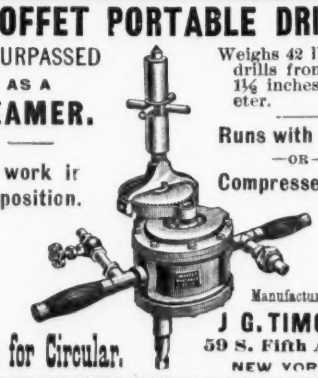


MACHINE TAPPING
MADE EASY
BY USING
Leland Tapping Attachment,
BUILT BY
HAMPDEN TOOL CO.,
HOLYOKE, - - MASS.
Does not break taps. Requires no adjustment from one size of taps to another.
Send for Circular.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

MOFFET PORTABLE DRILL.
UNSURPASSED AS A REAMER.
Will work in any position.
Weighs 42 lbs. and drills from ⅜ to 1¼ inches diameter.
Runs with Steam
—OR—
Compressed Air.



Send for Circular.
Manufactured by
J. G. TIMOLAT,
59 S. Fifth Ave.,
NEW YORK

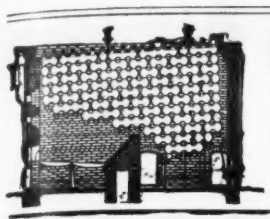
Largest Line in the U. S.
Complete Outfits or Single Machines Furnished for any Purpose.
THE EGAN CO.,
239 to 259 W. FRONT ST.,
CINCINNATI, OHIO, U. S. A.
Originators and Builders of
Wood-working Machinery
OF THE MOST ADVANCED TYPE FOR THE SAVING OF TIME AND LABOR.
Pattern Machinery a Specialty.
Send for Catalogue.
New York Office, 112 Liberty Street.

Pat. KEY-SEAT SETTING GAUGE
PATENT UNIVERSAL DEPTH ANGLE AND SCREW-CUTTING CENTER
J. WYKE & CO TWIST DRILL GAUGE
Tool Machinists' Tools. E. BOSTON, MASS. Send for LISTS

FRICTION CLUTCH PULLEYS and CUT-OFF COUPLINGS.
THE WOODCOCK CLUTCH
Simplest and best in the world. Address
ALLENTOWN FOUNDRY & MACHINE CO.,
ALLENTOWN, PA.

Root's Force Blast Rotary Blower.
FOR
FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.
Best Mechanical Construction.
P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt. 163 & 165 Washington St.
COOKE & CO., Selling Agts. NEW YORK.
In Writing Please Mention This Paper.



Absolute Safety from Destructive Explosion—Highest Attainable Economy of Fuel—Rapid Generation of Dry or Superheated Steam—Durability—Low Cost of Maintenance—Ease of Transportation and General Efficiency are among the advantages possessed by the "Wharton-Harrison" form of boiler.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H.P up.

State requirements and consider our proposition.

HARRISON SAFETY BOILER WORKS,
PHILADELPHIA, PENNA.

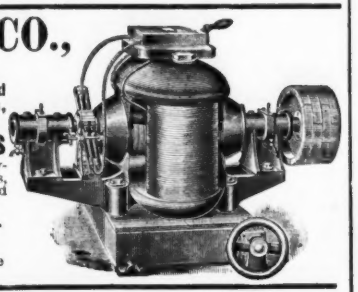
NEW YORK, N. Y. 41 Dey Street. CHICAGO, ILL. 187 La Salle Street. ATLANTA, GA. 9 No. Pryor Street.

THOS. H. DALLETT & CO.,
York Street & Sedgley Ave., Philadelphia.

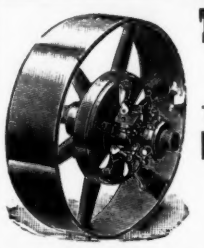
Manufacturers of
Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.

ELECTRIC MOTORS
Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses and other Machinery.

ELECTRIC GENERATORS,
For installation of Complete Power Plants.

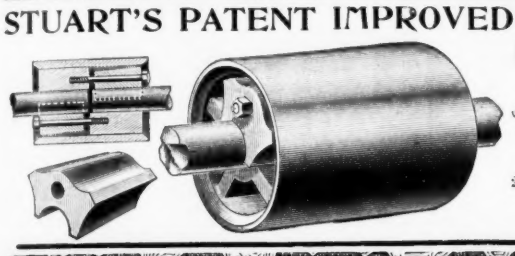


PORTABLE DRILLING MACHINES,
MANUFACTURED BY
Albert L. Colburn,
No. 4 Wall Street,
NEW HAVEN, CONN.
Send for Catalogue.



The Moore & White Co.,
15th St. & Lehigh Ave.,
PHILADELPHIA, PA.
MFRS. OF
The "Moore & White"
Friction Clutches
AND
Cut-off Couplings.
Send for Circulars.

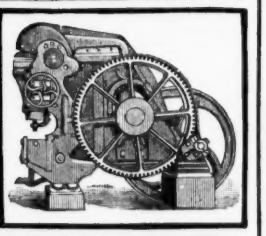
STUART'S PATENT IMPROVED WEDGE COUPLING.



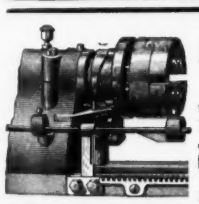
NO KEYS NOR KEY SEATING.
SENT ON TRIAL.
Can be attached or removed in a few seconds without injury to shaft or coupling.
SIMPLEST and BEST in MARKET, Also the Cheapest.
Send for discounts and illustrated Price List of 20 sizes.
ROBERT J. STUART,
NEW HAMBURGH, N. Y.

Norton Emery Wheel Co.
SEND FOR ILLUSTRATED CATALOGUE
Worcester, Mass.

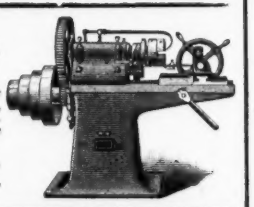
PUNCHING AND SHEARING MACHINERY
AND BOILER MAKERS ROLLS.
NEW DOTY MANUFACTURING CO.
JANESVILLE WISCONSIN.



ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".



The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.
Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.



NEW ADJUSTABLE BENCH LEVEL.
WITH GROUND AND GRADUATED VIAL.
4-6 & 8 inch.

Three Sizes.
MANUFACTURED BY
C. F. RICHARDSON,
ATHOL, MASS.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
MACHINIST,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.

CRUCIBLES
FROM ¼ LB. TO 600 LBS. CAPACITY

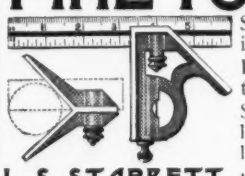
RETORTS. BOWLS. DIPPERS. STIRRERS. STOPPERS. COVERS.

BLACK LEAD CRUCIBLES
MADE BY THE
JOS. DIXON CRUCIBLE CO, JERSEY CITY, N. J.
ARE THE STANDARD THE WORLD OVER,
AND GUARANTEED THE BEST CRUCIBLES MADE.
CALL FOR
DIXON'S BLACK LEAD CRUCIBLES, AND TAKE NO OTHER.

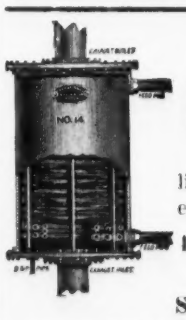
MARK YOUR TOOLS WITH A STEEL STAMP.

SEND FOR PRICE LIST NO. 4.

STARRETT'S
FINE TOOLS



Skilled mechanics prefer them. Live dealers sell them.
Send for free illustrated Catalogue.
L. S. STARRETT, Athol, Mass., U.S.A.
LONDON AGENTS: Chas. Churchill & Co., Limited, 21 Cross St., Finsbury, E. C.



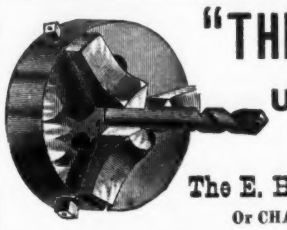
THE NATIONAL
Feed-Water
HEATER.
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
100,000 Horse power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

Westcott Chuck Co., Formerly **Oneida Steam Engine & Foundry Co.,** **Oneida, N. Y., U.S.A.**
Manufacturers of all kinds of
LATHE AND DRILL
CHUCKS.
Send for Illustrated Catalogue.

Under Westcott's Patent.
Capacity Little Giant Improved.

No.	Diameter.	Holding Drills.
00	1¼ inch.	0 to ¼ inch.
0	2¼ "	0 to ½ "
1	2¾ "	0 to ⅝ "
2	3½ "	0 to 1 "
3¼	4 "	0 to 1 in., ex. strong.
3	6 "	0 to 1¼ inch.
4	6¼ "	0 to 2 "

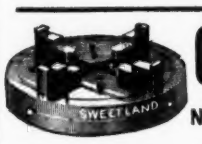
"THE HORTON LATHE CHUCK."
MORE THAN 300 SIZES AND STYLES. COMPRISING
Universal Chucks, Independent Chucks, Combination Chucks,
Of Every Description. Send for 52 page Illustrated Catalogue.
The E. HORTON & SON CO., Windsor Locks, Conn., U. S. A.
Or CHAS. CHURCHILL & CO., Ltd., 21 Cross St., Finsbury, London, Eng.



NOTICE

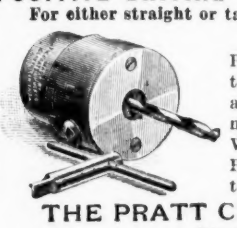
We have just added to our line of patent Face-Plate Jaws an 8 inch. We now carry in stock three sizes—8 inch, 10 inch and 12 inch.

Send for new Catalogue of Chucks to
THE CUSHMAN CHUCK CO.,
HARTFORD, CONN.



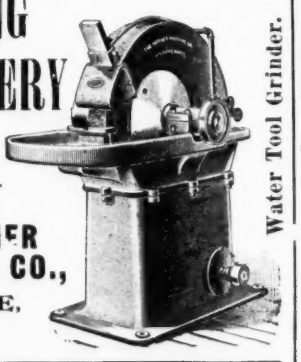
CHUCKS
ALL STYLES.
NEW REVERSIBLE JAWS
(DOVETAILED.)
MANUFACTURED BY
THE HOGGSON & PETTIS MFG. CO.,
Est. 1849. NEW HAVEN, CONN.

POSITIVE DRIVING DRILL CHUCK.
For either straight or taper Shank Drills.



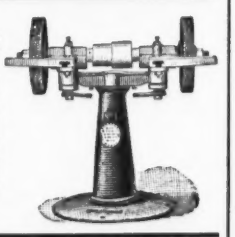
Has the Holding Power of Taper Socket together with all the advantages of the common Friction Chuck. Write for Illustrated Price List and Discounts to
THE PRATT CHUCK CO.,
Clayville, N. Y., U. S. A.

GRINDING MACHINERY

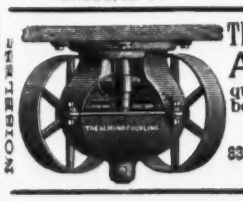


Water Tool Grinder.
PRICES ON APPLICATION.
THE HORNER MACHINE CO.,
HOLYOKE, MASS.

McGRATH'S PATENT
Emery Grinding, Polishing and Buffing Machines.
Bearings yielding or rigid at will
Wheels *always true and in balance*, dispensing with use of diamond tool and chilled burr, and saving the time, labor, and cutting away of wheels, *otherwise wasted in truing*. Send for Catalogue.
McGRATH & COLLINS,
COHOES, N. Y.

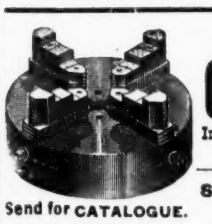


NOISELESS



The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street
BROOKLYN, N. Y.

1884 PATENT CHUCKS.
We make a specialty of geared scroll chucks in diam's below 12". For many uses a scroll chuck cannot be excelled. Ask at your dealers for our 1884 Patent or write for our catalogue.
THE D. E. WHITON MACHINE CO.,
5 Oak St., NEW LONDON, CONN.
S. A. SMITH, 23 S. Canal St., Chicago, Western Agt.



SKINNER CHUCKS
Independent, Universal and Combination LATHE CHUCKS.
—Also, DRILL CHUCKS.—
SKINNER CHUCK CO.
NEW BRITAIN, CONN.
Send for CATALOGUE.

Chucks The **NATIONAL.**
INDEPENDENT, UNIVERSAL, COMBINATION.
Strongest. Easiest to change. Best finish. **Reversible Jaws** (patented) giving 5 changes including every possible desired position. NEW CATALOGUE, illustrated, sent free. Liberal discounts. Prompt shipment. Address
THE NATIONAL CHUCK MANUFACTURING CO.,
132nd Street and Park Ave., New York City.

ALUMINUM!
THE COWLES ELECTRIC SMELTING & ALUMINUM COMPANY,
Lockport, - New York,
Offer Pure Aluminum in Ingots, Slabs, Sheet, Wire and Castings at lowest market rates.
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze.

SAW TABLES
FOR
PATTERN MAKERS.
ROYLE MACHINE WORKS,
PATERSON, N. J.

HYDRAULIC MACHINERY,
PRESSES, PUMPS, PUNCHES, JACKS, VALVES, FITTINGS, PACKINGS, ACCUMULATORS.
WATSON & STILLMAN, Mfrs.
204, 206, 208 & 210 E. 43D ST., NEW YORK.

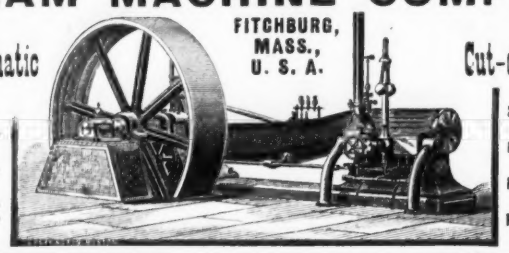
CLAW JACK.

VREELAND TRANSFER JACK.

In use on over **50** Railroads.

PUTNAM MACHINE COMPANY,

BUILDERS
New Putnam Automatic
Putnam Standard Lathes.
Putnam Gap Engine Lathes.
Putnam Speed and Drilling Lathes,
Putnam Pattern Makers' Lathes,



FITCHBURG, MASS., U. S. A.

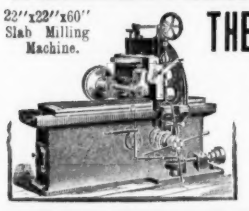
OF THE
Cut-off Steam Engine,
Putnam Bolt Cutters,
Putnam Car Wheel Borers,
Putnam Hydrostatic Presses,
Putnam Railroad Cranes

20 IN. 25 IN. & 30 IN. SWING.
TURRET CHUCKING LATHES
UNIVERSAL RADIAL DRILL CO.,
CINCINNATI, O. U.S.A.

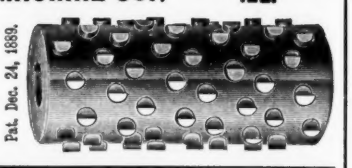
BENCH DRILL PRESSES

ARE OUTSELLING ALL OTHERS.
SEND FOR NEW DRILL PRESS PAMPHLET.
MILLIKEN, D'AMOUR & CO., MFRS.,
51 JOHN & 2 DUTCH STREETS, - - - - - NEW YORK.

22"x22"x60" Slab Milling Machine.



THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILL.
Manufacturers
INGERSOLL PATENT CUTTERS,
Ingersoll Slab Milling Machines.
Designers and Builders of
SPECIAL MILLING MACHINES
AND SPECIAL MACHINERY.
Correspondence Solicited.



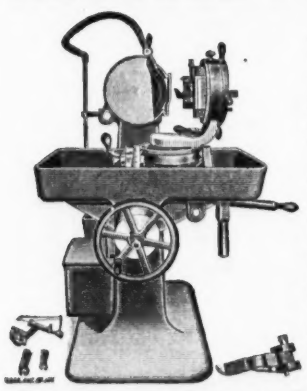
Pat. Dec. 24, 1889.

TRASK MILLING MACHINE CO.,

MANUFACTURERS OF

GEAR CUTTERS,
Bevel, Mitre, Straight-Face, and Irregular Cutters
OF ALL DESCRIPTIONS
FOR
MILLING METALS.
118 SOUTH STREET, BOSTON, MASS.

REDUCED PRICE.



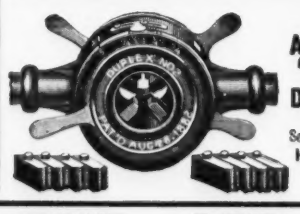
On account of the economy resulting from the manufacture of our Universal Tool Grinding Machine in lots of 50, we are enabled to reduce the price materially while adding to the efficiency of the machine by supplying all attachments. SEND FOR CIRCULAR.
GISHOLT MACHINE CO., Madison, Wis.

FOR CATALOGUE OF NEWEST AND BEST MACHINISTS' FINE TOOLS
WRITE
ATHOL, MASS.
STANDARD TOOL CO.

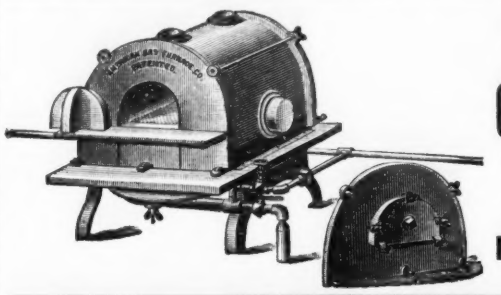
American Standard Gauge & Tool Works,
WILMINGTON, DEL.
Makers of Implements for Standard Measurements.

Over 52,300 in Use
Crescent Gauge.
Flat Bar Gauge.
JAS. A. TAYLOR & CO.

BICKFORD DRILL CO.,
BUILDERS OF
UPRIGHT RADIAL AND UNIVERSAL Radial Drills.
Boring & Turning Mills.
3 PIKE ST., CINCINNATI, O.



HART'S ADJUSTABLE "DUPLEX" DIE STOCKS
FOR PIPE.
Send for Illus. Circular.
HART MFG. CO.,
16 Wood Street, Cleveland, Ohio.



American Gas Furnace Co.
Designers and Manufacturers
GAS BLAST FURNACES.
Send for Catalogue. Estimates made for any mechanical operation requiring high, even and controllable temperature.
No. 80 NASSAU STREET,
NEW YORK.

A. R. KING M'F'G COMPANY,

ERIE, 11th and 12th Streets, JERSEY CITY, N. J.
HEAVY AND LIGHT CASTINGS IRON OR BRASS.
MFRS. OF BOILER MAKERS' TOOLS, SCREW PUNCHES, TUBE EXPANDERS, PACKER RATCHETS, TUBE CUTTERS, ETC.
GENERAL MACHINE WORK. Write for CATALOGUE. CORRESPONDENCE INVITED.

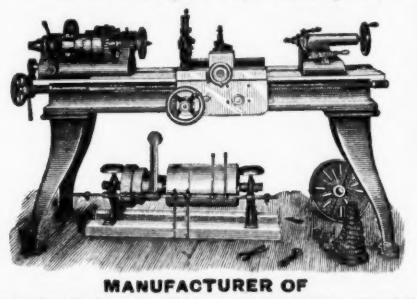
THE STANDARD TOOL CO., Cleveland, Ohio.

Manufacturers of STRAIGHT-LIP INCREASE TWIST DRILLS

SOLID AND SHELL REAMERS, MILLING CUTTERS, TAPS, SOCKETS.
"STANDARD" TWIST DRILL GRINDING MACHINE CHUCKS AND SPECIAL TOOLS.

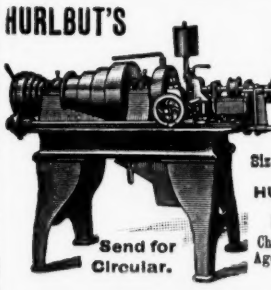
A. FALKENAU,

11th Street & Ridge Ave., Philadelphia, Pa.

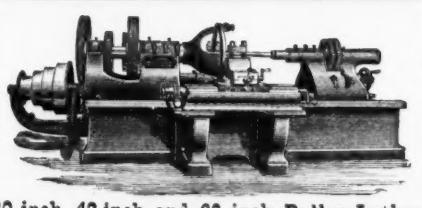


MANUFACTURER OF
SUPERIOR 14-INCH LATHES, TOOL GRINDING MACHINERY, TRAVELING CRANES, ETC.
Special Machinery designed and constructed.

HURLBUT'S Patent Cutting-off and Centering Machine.



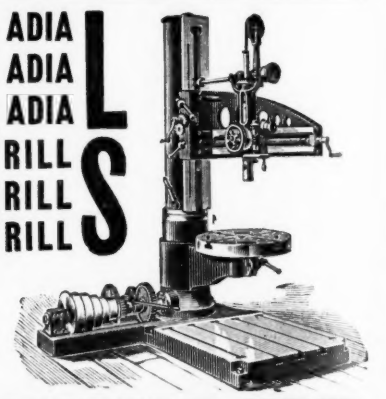
Send for Circular.
Sizes, 2", 3", 4", 5", 6"
MADE BY
HURLBUT, ROGERS MACHINE CO.
South Sudbury, Mass.
Chas. Churchill & Co., Ltd. Agents, 21 Cross St., London, England.



30 inch, 42 inch and 60 inch Pulley Lathes
For Simultaneously Boring and Turning Pulleys, both straight and crowning face, Cone Pulleys, Gear Blanks, and a variety of other work specially adapted for turning and boring Blanks for Motor Gears.
Manufactured by
The Henley Machine Tool Works,
RICHMOND, IND.
Duplicate Circular mailed on application.

FOR
Substantial, Well Made, Low Price, Patented,
20 Inch Drills,
With latest improvements. Lever, Combination or Wheel Feed, address
Sibley & Ware,
SOUTH BEND - INDIANA.

RADIAL DRILLS



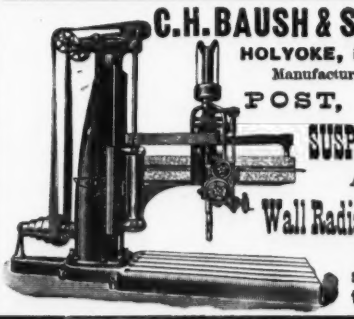
ENTIRELY NEW.
PATENTED NOV. 3, 1891.
From 3 ft. to 8 ft. Swing.
Will be sent to any responsible firm on trial.
ADDRESS
DIETZ, GANG & CO., Cincinnati, O.

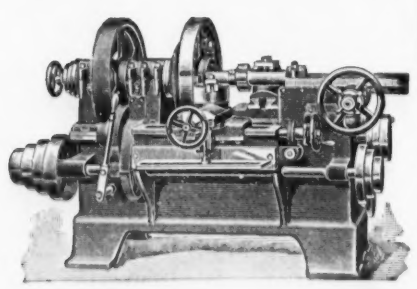
THE McNAULL UNIVERSAL RADIAL DRILLS.

Newest and best in the market. Furnished in five sizes, from a wall to a 10-ft. swing. Send for circulars.
McNaull Mach. & Fdy. Co.
RONCEVERTE, W. VA.

NO KEYS OR KEYSEATS
NICHOLSON'S COMPRESSION SHAFT COUPLINGS.
W. H. NICHOLSON & CO., - WILKES-BARRE, PA.

C. H. BAUSH & SONS.
HOLYOKE, MASS.
Manufacturers of
POST, SUSPENDED AND Wall Radial Drills
From the smallest to the largest.





THE AERATED FUEL COMPANY'S SYSTEM

Gives the best oil fire. Does not increase insurance. 200 plants in use, for 50 varieties of work. Forging and Tempering a Specialty. Send for Catalogue to W. S. COLLINS, 45 and 46 Drexel B'ld'g, New York. GILBERT & BARKER MFG. CO., General Agents for the U. S., SPRINGFIELD, MASS.

PULLEY LATHES.

We have reached the limit in rapid production of Pulleys round and true.
19 PATENTED FEATURES.
Sizes 20 in., 26 in., 30 in., 36 in. and 60 in. If you are in the market, write us before purchasing. We will give you better value for the money than any tool you are using.
WM. LODGE, President. OHIO MACHINE TOOL WORKS, Cincinnati, Ohio.

MORSE TWIST DRILL AND MACHINE COMPANY,

Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

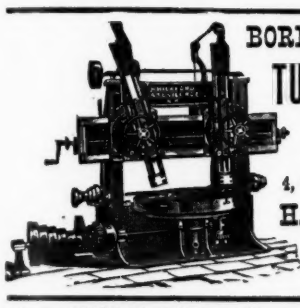
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

F. E. REED & CO.,
Worcester, Mass.
MANUFACTURE
ENGINE LATHES
HAND LATHES, FOOT LATHES AND MILLING MACHINES.
Manning, Maxwell & Moore,
Selling Agents, 111 Liberty St., New York.
515 Phenix Building, Chicago.

PLAIN MILLING MACHINES

SOMETHING NEW.

The Cincinnati Milling Machine Co.,
CINCINNATI, OHIO.

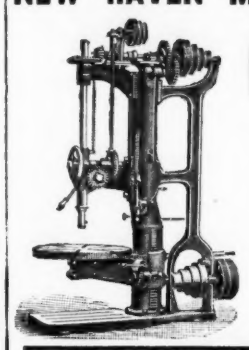


BORING AND TURNING MILLS,
4, 5 & 6 Ft. Swing.
H. Bickford,
Lake Village, N. H.

W. C. YOUNG M'F'G CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

NEW HAVEN MANUF'G CO.,

New Haven, Conn.



Lathes, Planers, Shapers, Slotters, Etc.

---

2 BY 24 FLAT TURRET LATHE.

Send for CATALOGUE for '92.
JONES & LAMSON MACHINE CO.,
Springfield, Vt., U. S. A.

MULLER LATHES

PATENTED.
With New and Valuable Features.
MADE ONLY BY THE
BRADFORD MILL CO.,
8th and Evans, CINCINNATI, O.
London House: CHAS. CHURCHILL & CO., L'td, 21 Cross St., Finsbury, London, E. C., Eng.

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Ltd, Agents, 21 Cross St., Finsbury, London, England

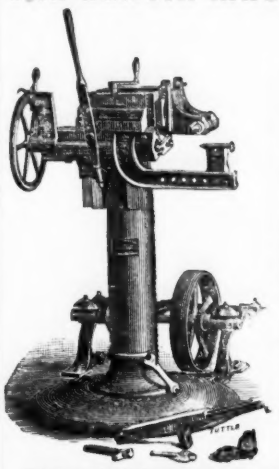
---

IRON PLANERS,

Extra Heavy. Latest Design. All Modern Improvements.

L. W. POND MACHINE CO., WORCESTER, MASS.

THE GARVIN MACHINE CO.



SMALL GEAR CUTTER.
This handy little machine is intended for rapid and convenient cutting of fine gears, ratchets, etc., used in telegraphic and mathematical instruments, etc.
GEAR AND RACK CUTTING A SPECIALTY.
MANUFACTURERS AND DEALERS IN IRON-WORKING MACHINERY.
LAIGHT & CANAL STS., N. Y. CITY.

CATALOGUE SENT ON APPLICATION.

BARNES' WATER EMERY TOOL GRINDER

Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. Send for Catalogue and Prices.

W. F. & John Barnes Co.
1995 RUBY ST.,
ROCKFORD, ILL

ENGLISH AGENTS.
CHAS. CHURCHILL & CO., LTD.
21 CROSS ST., FINSBURY, LONDON, E. C., ENG.

GAGE MACHINE WORKS,

FOX & TURRET LATHES A SPECIALTY.

MANUFACTURERS OF
MACHINE TOOLS,
WATERFORD, N. Y.

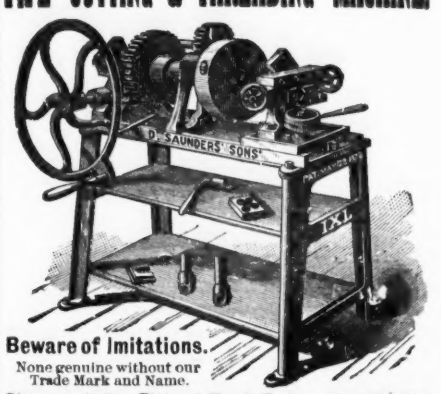
OUR SPECIALTY
CRANK and GEARED SHAPERS.
J. STEPTOE & CO., Cincinnati, O.
Geo. Place Machine Co., Agents, New York.

THE WORCESTER
DRILL GRINDER.
SIMPLE IN CONSTRUCTION, EFFICIENT IN OPERATION, MODERATE PRICE.
Endorsed by such concerns as
BROWN & SHARPE MFG. CO., THE PRATT & WHITNEY CO.
And over 600 others.
SEND FOR NEW ILLUSTRATED CIRCULAR.
The Washburn Shops, Worcester, Mass.

P. BLAISDELL & CO.,
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.

D. SAUNDERS' SONS

MANUFACTURERS OF THE ORIGINAL
TRADE I. X. L. MARK.
PIPE CUTTING & THREADING MACHINE.



Beware of Imitations.
None genuine without our Trade Mark and Name.
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
SEND FOR CIRCULAR.
21 Atherton St., YONKERS, N. Y.

For Sale by CHAS. CHURCHILL & CO., Ltd. 21 Cross Street, Finsbury, London, England.

PRENTICE BROS.
Manufacturers of
Lathes & Upright Drills.
Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world.
Worcester, Mass.

Price $10
NO GAUGES.
NO BELT.
Every Machine Guaranteed.

BARKER'S IMPROVED CENTER GRINDING MACHINE.
Manufactured by
WM. BARKER & CO.
CINCINNATI, O.
SEND FOR CIRCULAR.

25", 28", 36" Swing.

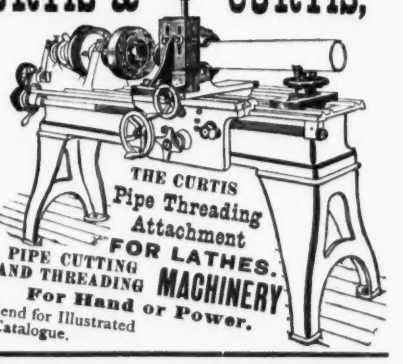
PALATINE, W. VA., April 19, 1890.
J. E. SNYDER, Esq., Worcester, Mass.

Dear Sir:—Answering yours of 12th inst., we are entirely satisfied with the 28 in. Drill bought of you. We looked at nearly all the prominent drills in the market before purchasing, and are satisfied that we made no mistake in purchasing your drill.

Yours truly,
BEESON & HELMICK.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



THE CURTIS Pipe Threading Attachment FOR LATHES.
PIPE CUTTING AND THREADING MACHINERY
For Hand or Power.
Send for Illustrated Catalogue.

NEW SHOP. PERFECT EQUIPMENT. NO MAKESHIFTS.

AMPLE ROOM. PERFECT LIGHT. EASILY REACHED.

Having added a Blacksmith Shop containing a 350 lb. Steam Hammer to our already extensive plant, we are now prepared to estimate on forgings of all kinds. We carry a full line of milling cutters in stock.

W. D. FORBES & CO.,

HOBOKEN, N. J.

FINE TOOL AND MACHINE WORK.

CONTRACT, JOB, OR DAYS' WORK.

13th Street AND HUDSON, HOBOKEN.

We manufacture Planer Vises, Parallel Pieces and Wedges for use on the Shaper or Planer. Also Standard Arbors for truing up nuts.

SEND FOR OUR NEW CATALOGUE.

The "Simplex" Glass-Tube Cutter.

This simple little instrument will be found quite as effective in its operation as any one of the numerous Glass-Tube Cutters costing five times its price. Its trifling price places it within the reach of every one who has use for such a tool

PRICE, 25 CENTS EACH. Or sent by mail to any address upon receipt of a P. O. Money Order for 30 CENTS.

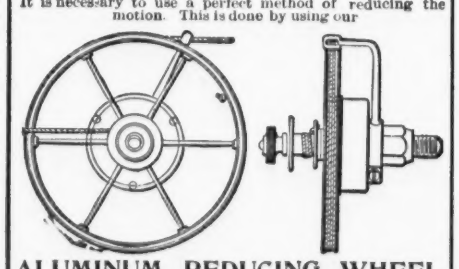
DO NOT SEND US ANY POSTAGE STAMPS.

It Sells at Sight

MANUFACTURED BY
PANCOAST & MAULE, Philada., U. S. A.

TO OBTAIN AN ACCURATE CARD WITH AN INDICATOR

It is necessary to use a perfect method of reducing the motion. This is done by using our

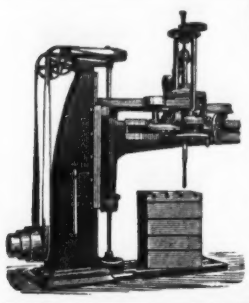


ALUMINUM REDUCING WHEEL

Lightest and only Perfect motion made. For circulars and prices address WEBSTER & PERKS TOOL CO.
Cor. Spring & Monroe Sts., Springfield, Ohio, U. S. A.

THE LARGEST ORDER

for Reducing Valves, ever received, was placed last week, by the Consolidated Car-Heating Co., with the **MASON REGULATOR CO. OF BOSTON.** It was for 500 Locomotive Reducing Valves. What inference do you draw from this?



WM. SELLERS & CO., Incorporated,

PHILADELPHIA, PA.

MANUFACTURERS OF

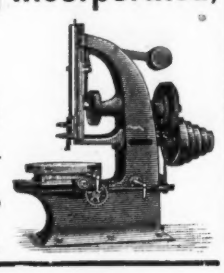
MACHINE TOOLS,

TRAVELING CRANES AND SWING CRANES,

Operated by Electricity, Shafts or Independent Engines.

Turn Tables, Testing Machines, Shafting, Pulleys, Hangers, Couplings, Etc.

INJECTORS FOR ALL CLASSES OF BOILERS.



BEMENT, MILES & CO., Philadelphia, Pa.

BUILDERS OF

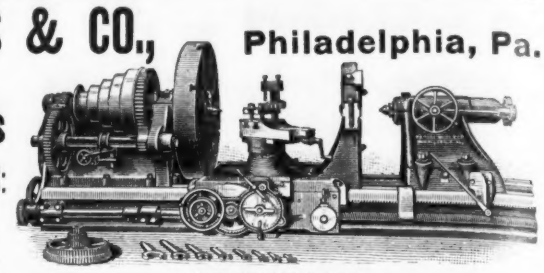
METAL-WORKING

MACHINE TOOLS

FOR RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC.

New York Office, Equitable Building.

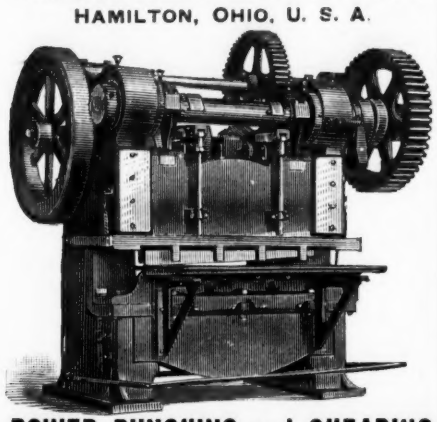
GEORGE PLACE, Agent.



NEW 63-INCH LATHE.

THE LONG & ALLSTATTER CO.

HAMILTON, OHIO, U. S. A.



POWER PUNCHING and SHEARING MACHINERY.

For Ship Builders, Boiler Makers, Bridge Works, Architectural Iron Works, Carriage and Wagon Makers, Agricultural Implements, etc., etc.

Correspondence stating requirements solicited.

ESTABLISHED 1842.

ROBERT POOLE & SON CO.

BALTIMORE, MD.,

ENGINEERS AND MACHINISTS.

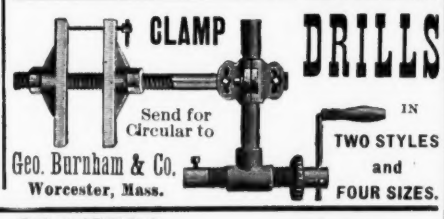
MACHINE MOULDED

GEARING.

ALL KINDS OF

TRANSMISSION MACHINERY

OF THE HEAVIEST CLASS.



CLAMP DRILLS

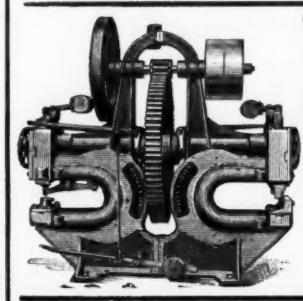
Send for Circular to

Geo. Burnham & Co.

Worcester, Mass.

IN TWO STYLES and FOUR SIZES.

The HILLES & JONES CO., WILMINGTON, DEL.



MANUFACTURERS OF

PUNCHES AND SHEARS,

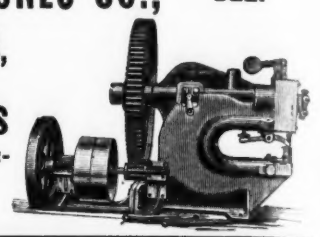
All Designs and Sizes,

AND A FULL LINE OF

MACHINE TOOLS

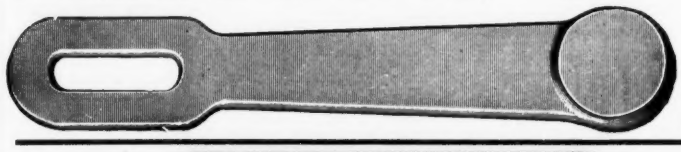
FOR

Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc., etc.



WYMAN & GORDON, WORCESTER, MASS.

DROP FORGINGS



THE OPEN SIDE IRON PLANERS.

THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.

LONGDALE IRON CO., Rolling Mill.

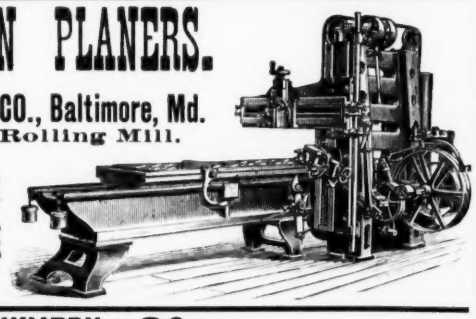
LONGDALE, Oct. 28, 1891.

GENTLEMEN: Replying to your favor of yesterday, we beg to say that the Open Side Planer of your make, which we have had in use nearly two years, has never failed to give us entire satisfaction.

It has not been called upon to do a very wide range of work, but whenever used, has done all that you stated it would. For repair shops, especially, it seems to me an admirably designed tool.

Very truly yours,

J. E. JOHNSON, Manager.



SIX SPINDLE

Turret Drills

SEND FOR CIRCULAR.

A. D. QUINT,

HARTFORD, CONN.

ACME MACHINERY CO.

CLEVELAND, OHIO.

Manufacturers of

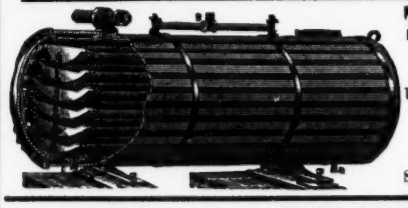
ACME BOLT & RIVET HEADERS,

Acme Single & Double Automatic BOLT CUTTERS.

Cutting from 1-8 in. to 6 in. diameter.

Also SEPARATE HEADS and DIES.

FIRST PREMIUM, CINCINNATI CENTENNIAL.



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers.

Using any kind of water. Hard Sheet Steel Troughs.

Easily Cleaned.

HOPPES MANUFACTURING CO.,

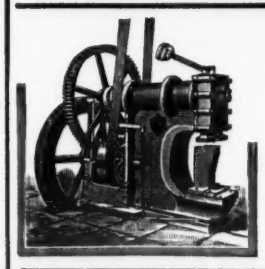
Send for Catalogue D. SPRINGFIELD, OHIO.

CRANES, PORTABLE HOISTS, OVERHEAD TRACK TROLLEYS.

SEND FOR CATALOGUE.

MARIS MACHINE CO.,

2343 & 2345 Callowhill St., PHILADELPHIA, PA.



UNIVERSAL PUNCHING PRESSES

FOR

PLATE, BEAM, CHANNEL OR ANGLE.

ESPECIALLY ADAPTABLE FOR

STRUCTURAL IRON WORK.

HETHERINGTON & BERNER,

INDIANAPOLIS, INDIANA.

Bolt and Nut Machinery.

Catalogue on Application.

Complete Outfits for Bolt and Car Shops.

Bolt Cutters, Bolt Pointers,

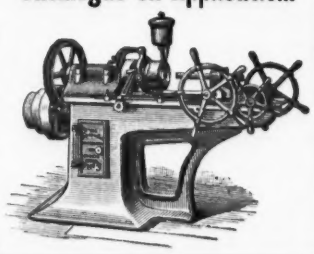
Upsetters and Benders,

Bolt Headers, Nut Tappers,

Nut Machines,

Washer Machines, Car Link and Pin Machinery.

The National Machinery Co., Tiffin, O.



THE ERIE KEY-SEATING MACHINE.

MANUFACTURED BY

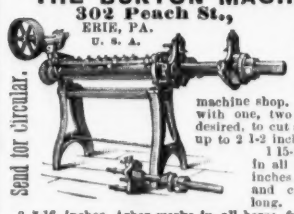
THE BURTON MACHINE CO.,

302 Peach St.,

ERIE, PA.

U. S. A.

Send for Circular.



The cut represents our Stationary and Portable Key-Seating Machine, which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors, as desired, to cut any width of key-seat up to 2 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter, and cuts seats 12 inches long.

2 7-16 inches Arbor works in all bores from 2 7-16 inches to 6 inches diameter, and cuts seats 16 inches long.

4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 26 inches long.

With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

The Morton Key-Seating Machine

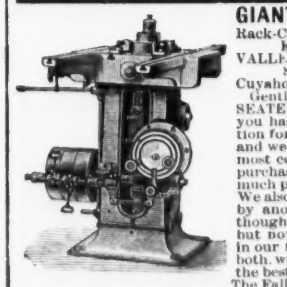
THE LEADER.

With recent patented improvements, we guarantee to do the following class of work.

To cut key-ways through 1¼-inch hole in hubs or sleeves 23 inches long, in iron, brass or steel, also make it dovetail to insert feather key

Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment takes the place of bolts, with a key-way and key to fit it.

For particulars address THE MORTON M'F'G CO., MUSKEGON HEIGHTS, MICH.



GIANT KEY SEATER.

Rack-Cutting Attachment Key Making Machines.

VALLEY MACHINE CO.,

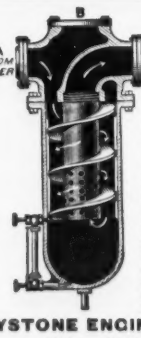
SAGINAW, MICH.

Cuyahoga Falls, O., Nov. 25, '91.

Gentlemen: The large KEY SEATER which we bought of you has now been in operation for a number of months, and we have been using it almost constantly since it was purchased, and we are very much pleased with it indeed. We also have a machine made by another firm, which we thought was a good machine, but now that we have both in our factory and use them both, we like yours very much the best.

The Falls Rivet & Machine Co.

LONDON AGENTS: Charles Churchhill & Co., Limited, 21 Cross St., Finsbury, E. C.



DRY STEAM.

Simpson's Centrifugal Steam Separator.

For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

KEYSTONE ENGINE AND MACHINE WORKS,

Fifth and Buttonwood Streets, Philadelphia,

Or, A. T. ARTHUR, Selling Agent, 18 Cortlandt St., N. Y.

Why Not Move

Nearer your best and biggest market—nearer your raw materials? **Chicago** is the greatest distributing point in America because of low railroad and lake freights everywhere; unrivalled location; belt-railways. **Chicago Heights** is the center of Chicago's manufacturing district. Can't you come

To Chicago?

We'll show you **Chicago Heights,** and offer you **strong inducements** to locate there. We have the property, the men and the money—and mean business, If you're a manufacturer, affected by the new, changed conditions of doing your business, write us; we have a "way out."

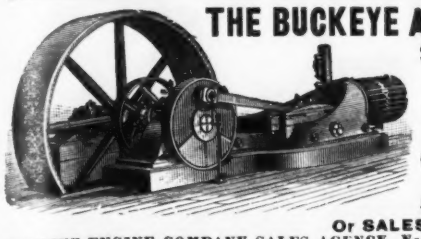
"Chicago's Beaten Path" is an illustrated and carefully-prepared booklet. Every manufacturer should have it. Send us your name and address. Here's ours:

THE CHICAGO HEIGHTS LAND ASSOCIATION,

(GET OUR RATING)

826-827 Chamber of Commerce, Chicago.

THE BUCKEYE AUTOMATIC CUT-OFF ENGINES.



SLOW SPEED, MEDIUM SPEED AND HIGH SPEED ENGINES,

Simple, Compound and Triple-Expansion Engines.

HIGH-PRESSURE BOILERS.

Complete Steam Power Plants of Highest Attainable Efficiency.

Address **BUCKEYE ENGINE CO., Salem, O.**

Or SALES AGENTS:

BUCKEYE ENGINE COMPANY SALES AGENCY, No. 10 Telephone Building, New York City.
A. A. HUNTING, John Hancock Bld'g, Boston, Mass. N. W. ROBINSON, 97 Washington St., Chicago, Ill.
ROBINSON & CARY COMPANY, St. Paul, Minn. A. L. FISH, No. 61 First St., San Francisco, Cal.
A. M. MORSE, 511 Commercial Building, St. Louis, Mo. J. M. ARTHUR & CO., Portland, Oregon.
KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.
Sole Licensees and Manufacturers for New Jersey (South of Trenton) Eastern Pennsylvania, Delaware, Maryland, and Virginia.

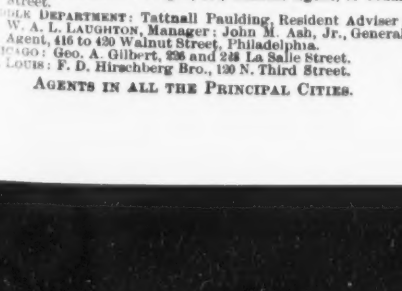
WANTED
ENGINEERS AND STEAM USERS
TO SEND FOR
OUR NEW CATALOGUE A OF STEAM SPECIALTIES.
JUST OUT. FREE TO ALL.

Containing TABLE OF PRESSURE, TEMPERATURE AND VOLUME OF STEAM.

ALBANY STEAM TRAP CO., Albany, N. Y.

"OTTO" GAS ENGINE WORKS.
SCHLEICHER, SCHUMM & CO.,
33d and Walnut Sts., PHILADELPHIA.
Branch Office, 151 Monroe St., CHICAGO.
New York Agency, 18 Vesey St., N. Y.

Over 35,000 Engines in Use



Guaranteed to consume 25 to 75 per cent. less Gas than any other Gas Engine doing the same work.

THE TWISS IMPROVED AUTOMATIC ENGINE
With LIBERATING Valve Gear.
Manufactured by NELSON W. TWISS, 25 Whitney Ave., NEW HAVEN, CONN.
Send for price before purchasing elsewhere.

ENGINES & BOILERS
Stationary & Semi-Portable.
8 to 25 HORSE-POWER.
High in Grade.
Low in Price.
Send for Pamphlet.
The **W. C. LEFFEL CO.**
Greenmount Ave., Springfield, O.

COMPTOMETER.
TRADE MARK.
Figures any and all kinds of Examples. *Operated by keys.* SAVES 60 PER CENT. OF TIME. INSURES ACCURACY. Needed in every counting-room Entire relief from mental strain. Why don't you get one! *Send fo. Circular.*
FELT & TARRANT MFG. CO.,
52 Illinois St., Chicago.

STRONG, WELL BUILT SERVICEABLE STEAM ENGINES
12 to 100 Horse Power
Every Engine tested under full load.

Adapted to Heavy, Continuous Work.
SUITABLE
Tubular & Firebox BOILERS
on hand for immediate delivery.
CHANDLER & TAYLOR CO. INDIANAPOLIS, IND

PATENT OILERS, CYLINDER SIGHT FEED CUPS.
Government Regulation
POP SAFETY VALVES,
For Stationary, Marine and Locomotive Boilers.
J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,
211 Race Street, Philadelphia, Pa.
CATALOGUE FREE ON APPLICATION.

STEAM

CONOVER CONDENSERS.
BELT AND STEAM DRIVEN.
Compound Condensing Corliss Engine on Independent Condenser.
HANDSOME CATALOGUE FREE.
THE CONOVER MFG. CO., 95 Liberty St., N.Y.

BELT

EMPLOYERS' LIABILITY ASSURANCE Corporation Limited London, Eng.

Deposited in the U. S $887,000.00.

Policies issued giving full protection to Employers against loss by Claims from Employes on account of Accident. Rates Proportioned to Risks of Occupation. One Premium the only Payment during year. No Contingent or other Liability on part of Employer.

CHIEF OFFICE IN THE UNITED STATES:
71 KILBY ST., BOSTON, MASS.
ENDICOTT & MACOMBER,
Managers and Attorneys.

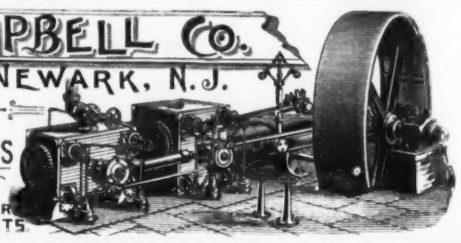
BOSTON: Samuel Appleton, 28 Central Street.
NEW YORK: Edmund Dwight, Jr., General Agent, 51 Cedar Street.
MIDDLE DEPARTMENT: Tattnall Paulding, Resident Adviser; W. A. L. LAUGHTON, Manager; John M. Ash, Jr., General Agent, 416 to 420 Walnut Street, Philadelphia.
CHICAGO: Geo. A. Gilbert, 226 and 228 La Salle Street.
ST. LOUIS: F. D. Hirschberg Bro., 120 N. Third Street.
AGENTS IN ALL THE PRINCIPAL CITIES.

THE
LACKAWANNA GREASE CUP
Has a wide reputation as the CLEANEST, MOST EFFECTIVE, and MOST ECONOMICAL device on the market for the lubrication of machinery bearings.
Liberal Discount to the Trade.
—MANUFACTURED BY—
Lackawanna Lubricating Co.,
SCRANTON, PA.

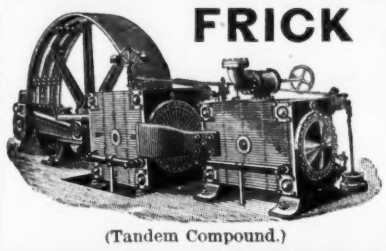
SWIVEL BASE.
OFFSET JAW VISE.

Specially adapted for drill press work where chucks cannot be used, and equally good for special or regular bench work.
Send for catalogue of full line of the most improved designed, and best finished machinists', plumbers', coach makers' and pattern makers' vises and small tools.
HOLLANDS MFG. CO.,
ERIE, PA.

THE WATTS, CAMPBELL CO.
MANUFACTURERS OF IMPROVED
CORLISS STEAM ENGINES
IN FULL VARIETY.
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS
NEWARK, N.J.



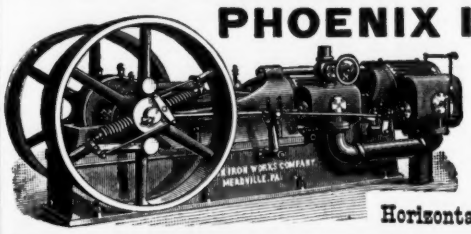
FRICK COMPANY, WAYNESBORO, PA.



(Tandem Compound.)

ECLIPSE CORLISS ENGINES,
40 TO 2,000 H. P., ALL STYLES.
Send for Illustrated Catalogue.
ALSO BUILDERS OF
Electric High Speed Engines and Ice-Making and Refrigerating Machinery.

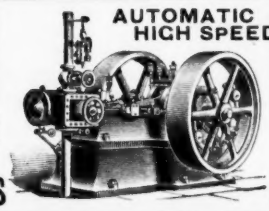
PHOENIX IRON WORKS CO.



MEADVILLE, PA.
New York, 15 CORTLANDT ST.
Chicago, 418 CHAMBER OF COMMERCE.
Sole Manufacturers of the
"Dick & Church" Automatic Cut-off Engine.
Single, Tandem Compound, and Triple Expansion.
Horizontal Tubular and Manning Vertical Boilers.

WESTON
HIGH PRESSURE BOILERS AND COMPLETE POWER PLANTS

AUTOMATIC HIGH SPEED



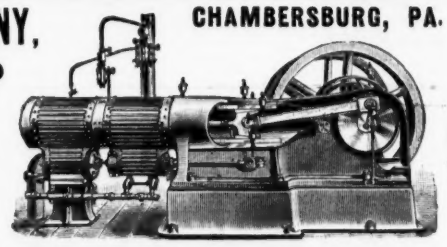
ENGINES
WESTON ENGINE CO.,
PAINTED POST, N. Y.
REPRESENTATIVES.
JULIAN SCHOLL & CO., 126 Liberty St., N. Y.
GEO. D. HOFFMAN, 82 Lake St., Chicago.
H. M. SCIPLE & CO., 3d & Arch Sts., Phila., Pa.

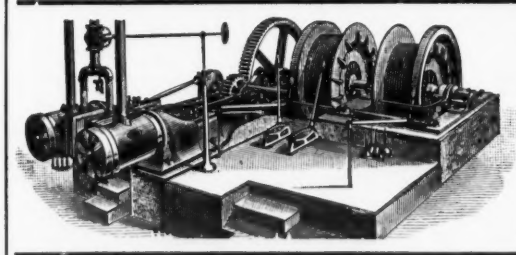
HIGH GRADE AUTOMATIC CUT-OFF ENGINES.
No other engine has a perfectly balanced valve.
OUR GUARANTEE. WHO DARE MEET IT?
The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work, will not reduce the speed of engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon payment of one dollar. Send for Catalogue.

SIMPLE, TANDEM AND CROSS COMPOUNDS

Branch Offices. 141 Liberty St. New York, N.Y. 1412 Washington Ave. St. Louis, Mo.
J. H. McEWEN MFG. CO. RIDGWAY, PA.

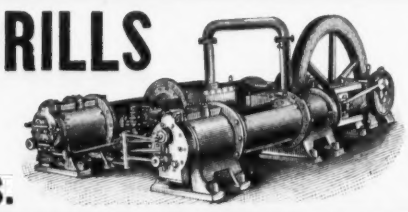
TAYLOR ENGINE COMPANY, CHAMBERSBURG, PA.
SINGLE AND COMPOUND
AUTOMATIC ENGINES.
BRANCH OFFICES:
165 Washington St., N. Y. | 28 W. Randolph St., Chicago.
45 N. 7th St., Philadelphia. | 99 1st Ave., Pittsburgh.
Haverhill St., Boston. | 179 Race St., Cincinnati.





WIRE ROPE
HOISTING AND HAULAGE PLANTS
For Coal Mines, &c., a Specialty.
OVER 100 NOW RUNNING SUCCESSFULLY.
Gum-lined Sheaves, Coal Crushers, Narrow Gauge Locomotives.
J. & J. B. MILHOLLAND,
240 Fifth Avenue, PITTSBURGH, PA.

ROCK DRILLS AND AIR COMPRESSORS.

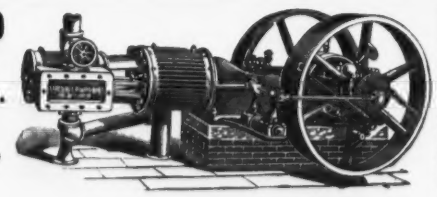


AIR COMPRESSORS WITH COMPOUND AIR CYLINDERS, AND COMPOUND STEAM CYLINDERS WITH MEYER OR CORLISS VALVES.
Rand Drill Co.,
23 Park Place,
NEW YORK, U. S. A.

LINK-BELT
ENGINEERING CO.
NICETOWN
PHILA.
49 DEY ST.
NEW YORK.

Elevators, Conveyors, Manila Rope Power Transmission Machinery, Ewart Detachable Link Belting, Dodge Chain, Howe Chain, etc. **Western Connection, Link-Belt Machinery Co., Chicago, Ill.**

THE IMPROVED BALL ENGINE.
AS BUILT BY
The Ball & Wood Co.
OFFICE,
15 Cortlandt Street,
NEW YORK.



Is superior in **DESIGN, FINISH** and **WORKMANSHIP.** In **REGULATION** and **ECONOMY** it has no equal. Built with new tools from new patterns and after long experience, it marks the latest step in steam engineering.

TO OUR PATRONS.

Providence, R. I., June 30, 1892.

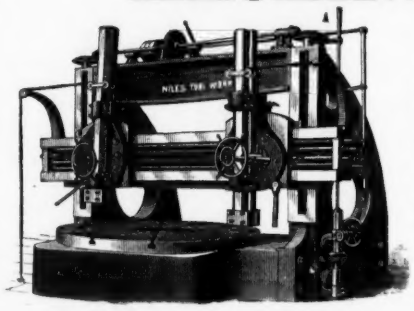
Our works will be closed from August 1 to 13, inclusive, for annual vacation and repairs. Please bear this in mind in connection with any orders you have in contemplation. The office will be kept open as usual, and all orders will be promptly filled for Machinery or Tools described in our Catalogue, and usually kept in stock.

Yours Truly,
BROWN & SHARPE MFG. CO.

BROWN & SHARPE MFG. CO.,
PROVIDENCE, R. I.

MACHINE TOOLS
On Exhibition at 23 South Canal Street, Chicago, Ill.
S. A. SMITH, Western Representative.

NILES TOOL WORKS,
HAMILTON, OHIO.
MACHINE TOOLS.



BORING AND TURNING MILLS
A SPECIALTY.

Built in sizes to swing from five feet diameter to thirty feet diameter. Housings are double-webbed. Table runs on heavy spindle supported by a truncated cone extending down from bed, making machine self-contained. Boring Bars counterbalanced at all angles. Feeds automatic at all angles.

Correspondence solicited.

12-FOOT BORING AND TURNING MILL.

NEW YORK, 136 & 138 LIBERTY ST. CHICAGO, PHENIX BLDG. PITTSBURGH, LEWIS BLOCK.

INCREASED SALES

Show that our customers appreciate the value of improvements made in

JENKINS PACKING.

It can be used again and again. Does not **ROT** or **BURN** out. Have you tried it recently? If not, DO SO! Look for "Trade Mark."

JENKINS BROS., New York Philadelphia, Boston and Chicago.

GRANES
THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

CHANCE FOR EVERYBODY.

$100.00 REWARD.

We will on April 1st, 1893, pay the following rewards:

$50.00 to the first, **$25.00** to the second, **$15.00** to the third, and **$10.00** to the fourth party or parties making the most valuable suggestions for novel features that may be applied to our display at the World's Fair.

Competition open to all except those in our employ.

Write us early and often.

THE LODGE & DAVIS MACHINE TOOL CO.
WORKS: CINCINNATI, OHIO.

NOTICE.

It is being circulated that some machines **can** do 50% and another special machine 1/3 more work than the Eberhardt

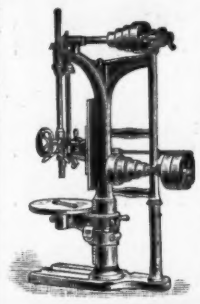
GEAR CUTTER.

We have yet to see the **one** that does it; the facts are, **we are cutting more** gears, either cast **iron** or **steel,** where our machines are placed alongside of these other machines. We can refer intending purchasers to shops where these are running.

We warn the consumer from purchasing **infringing** machines. Write to

GOULD & EBERHARDT,
NEWARK, N. J.

This is the machine that is cutting (with rare exceptions) all the Electric Motor Gears.

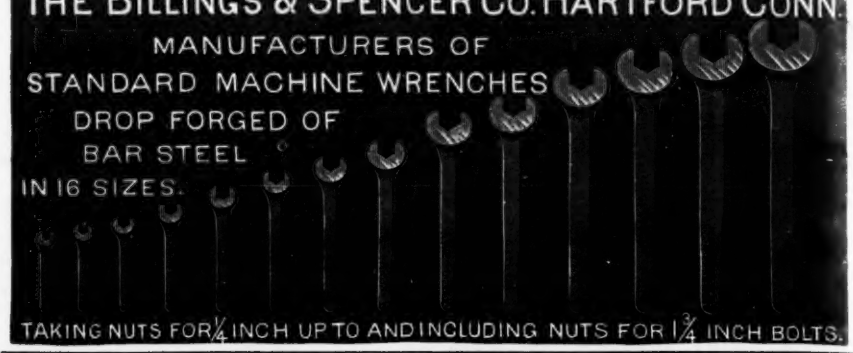


THE PRATT & WHITNEY CO.,
Hartford, Conn.,
MANUFACTURE

Renshaw's Ratchet Drills, Nos. 1 and 3; **Upright Self-Feeding Hand Drilling Machines** for Blacksmiths; **Upright Drilling Machines,** single and multi-spindle, both those in which the spindles are without feed movement and tables are operated by hand or foot lever, and those in which the tables have provision for adjustment, and spindles are fed by hand lever, or by hand wheel, or automatically; also, **Horizontal Drilling Machines,** single and multi-spindle.

WESTERN BRANCH, 100 West Washington St., Chicago, Ill.

THE BILLINGS & SPENCER CO. HARTFORD CONN.
MANUFACTURERS OF
STANDARD MACHINE WRENCHES
DROP FORGED OF
BAR STEEL
IN 16 SIZES.



TAKING NUTS FOR 1/4 INCH UP TO AND INCLUDING NUTS FOR 1 3/4 INCH BOLTS.

Vertical Milling Machine.

WARNER & SWASEY,
CLEVELAND, OHIO.
Machine Tools
FOR
Iron and Brass Work.
Send for Illustrated Catalogue.

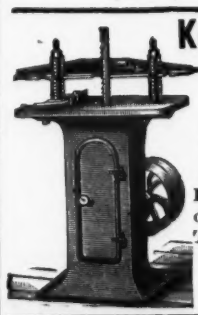
MANNING, MAXWELL & MOORE,
Manufacturers and Dealers in all kinds of
RAILWAY and MACHINISTS' TOOLS AND SUPPLIES.

The Celebrated F. E. REED 16-inch Swing Engine Lathe.

111-113 LIBERTY ST., NEW YORK.

We carry the largest line of Tools and Supplies in the City.

GEO. W. FIFIELD,
MANUFACTURER OF
ENGINE LATHES
FROM 17 to 50 IN. SWING.
Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.



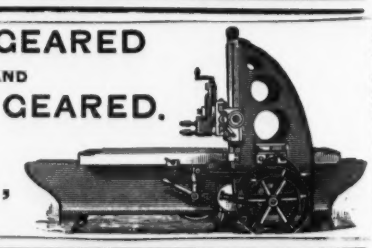
Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

Gear Wheels and Gear Cutting.
Grant's Gear Book for 1892, 15 Cents.
Lexington Gear Works,
Lexington, Mass.

PLANERS
SPUR GEARED AND SPIRAL GEARED.
MANUFACTURED BY
The G. A. GRAY CO.,
479 Sycamore St., CINCINNATI, O.



27" x 27" x 8" Planer.
20" x 6' Chucking Lathe.
16" x 6' Engine Lathe.
THE HENDEY MACHINE CO. TORRINGTON, CONN.
MANUFACTURERS OF MACHINE TOOLS.
SEND FOR OUR CATALOGUE

25" Pillar Shaper.
CHAS. CHURCHILL & CO., Agts.
21 CROSS ST.,
Finsbury, London, Eng.

Manufacturer —of— TAPS & DIES